A. Brooks

THE

ALLAHABAD FARMER

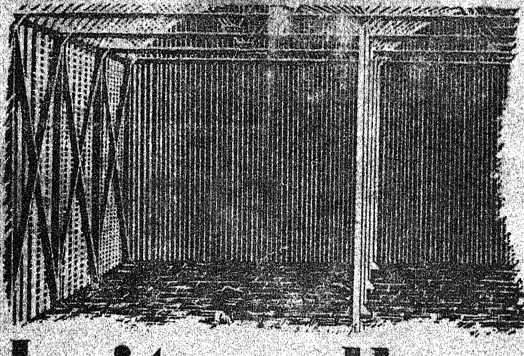
A BI-MONTHLY JOURNAL

OF

AGRICULTURE AND RURAL LIFE

CONTENTS

Vol. XXII JANUARY, 1948 No. 1



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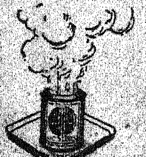

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THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL OF AGRICULTURE AND RURAL LIFE

The ALLAHABAD FARMER is now approved by the Directors of Public Instruction in the ·nited Provinces, Bengal, Central Provinces, Sind, Assam, Bihar and Orissa, the Rural Re- onstruction Commissioner, Punjab, and by the Director of the Institute of Plant Industry, ndore, and Agricultural Adviser to Rajputana and Central India States, for use in all schools nder their jurisdiction.

Subscription Rates

Annual subscription : India, Rs. 3 ; England, 4 shillings ; U.S.A., 1 dollar. Single copies annas ; over five years old, 12 annas. Copies which are not received by subscribers will supplied free of cost within six months of the month of issue. Thereafter single copy price ill be charged.

Unused portions of subscriptions cannot be refunded.

Advertising Rates

	Rs.	a.	p.
One full page of six numbers	35	0	0
One single full page	7	0	0
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One single half page	4	0	0
Page 2 or 3 of cover for six numbers	50	0	0
Page 4 of cover for six numbers	70	0	0

Contributions

The ALLAHABAD FARMER is published in the first week of each alternate month com- oncing with the month of January. Contributors are requested to send in their articles at ast one month prior to the next prospective date of publication.

Contributors will receive 15 reprints of the article published and additional copies at cost.

Publisher—The Allahabad Agricultural Institute, Allahabad, U.P. (American Presbyterian Mission).

Printer—The Mission Press, Allahabad, U.P.

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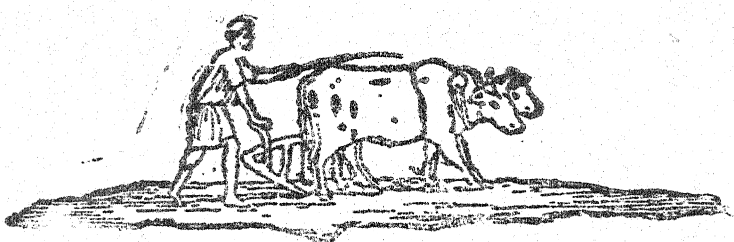

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CALENDAR OF OPERATIONS: AN IMPORTANT TECHNIQUE OF GOOD FARM MANAGEMENT.

By

H. S. AZARIAH.

One of the major factors that affects profits in farming is the way crop and livestock enterprises are selected and combined in a farm. The advantages of having a good combination of enterprises are many. A good combination of enterprises increases the aggregate income that could be secured from a farm. It also affects the distribution of the use of bullocks, equipment and labour. Better utilization of bullocks and farm equipment will minimize the cost of operation of the farm. Furthermore, a good combination of enterprises will ensure a periodic cash income which will help considerably in meeting the working expenses of the farm and appreciably reduce the amount of money to be borrowed for operating the farm. Besides, conservation of soil and the maintenance of productivity are easier to handle with carefully selected enterprises.

The smaller the size of farm business, the more important it is to have the right combination of enterprises. Firstly, the land is too valuable to be occupied by unimportant crops Secondly, the operator's time is not likely to be fully utilized. Lastly, bullocks also may be periodically idle. Similarly, when labour costs are high as in these days, it is doubly important that the farmer does not squander his time with unproductive and unimportant work. The problem is therefore of great importance to our farmers to-day.

Of the factors that should be considered in the selection and combination of enterprises on a farm, the distribution of labour to avoid any conflict in labour requirements and the relative profitableness of different enterprises are probably the most important ones. In this paper we shall deal with the distribution of labour and the technique of adjusting labour to avoid conflict and unnecessary waste; and in a subsequent article we propose to take up the question of relative profitableness of various enterprises.

In order to have proper distribution of labour, a knowledge of farm operations that have to be done each month in a particular region is essential. Such a statement either in a chart or tabular form is what is known as "calendar of operations", and is put out by many provincial Departments of Agriculture. These are helpful to amateurs and to those who are new to a region. A farmer who has been brought up in a farming environment need not be told when to sow, irrigate, cultivate and harvest a particular crop. He knows them very well indeed. What is needed, is an exact knowledge of labour requirements for each crop for a definite area by at least ten-day periods. Ten-days are considered as the "grace period" within which certain farm operations must be done. Calendar of operations as under in this land is, therefore, too general to be of use. An attempt is made here to show how every region and every farm can secure this most useful information by carefully kept records.

All that is needed is a register where a daily record could be made of the amount of bullock work, equipment and labour that have been used for each crop and livestock enterprise. The farm office of the Allahabad Agricultural Institute, in consultation with the department of Agricultural Economics has adopted the following rulings for such an "Operations Register":—

Serial No.	Crops	1 (Date)			—	Total for the Month		
		Bullock Days	Equipment Days	Man Days		B. D.	E. D.	M. D.
1	Wheat etc. ..							
	Total ..							

Since 1943, the Institute farm has kept an accurate day to day records of all bullocks, equipment and labour used on the farm. These were studied and are here presented in tabular and chart forms. The data presented were taken from three crop-years, 1943—44 ; 1944—45 and 1945—46. These charts (figures 1—8) and the table (No. 4) give the labour distribution for Allahabad by Ten-day periods for eight most important crops now grown on the Agricultural Institute farm.

The charts graphically depict the situation and therefore are easier to understand. If one chart is compared with another, any conflict in labour requirements could be easily noticed. For example, in Allahabad wheat and hill-potatoes go well together, whereas there will be conflict in labour requirements if wheat and early potatoes occupy a large acreage on the same farm. This conflict can be minimized by the use of proper implements and by a change in the technique of cultivation (figures 9 and 10). The same conclusion is reached from table 4 also, where circles indicate the periods of maximum labour for each crop. A possible confict in labour requirements during the harvest of maize and napier grass in August and of berseem and early potatoes in October—November can be foreseen from the table. Thus such tables and charts are most useful in estimating the labour required for a particular combination of crops and for detecting any conflict in labour. The critical periods for labour in Allahabad for certain crops are given in table No. 3.

TABLE No. 3.

Critical Periods for Labour Requirement for certain crops in Allahabad.

Crops	Critical Periods
Berseem	February and October
Early Potatoes	October—November
Hill Potatoes	April
Juar fodder	November —December
Maize	August—September
Napier grass	June and August
Oats	December
Wheat	March —April

One should try [illegible] e as even a distribution of labour as possible. New and [illegible] onal enterprises which demand

labour during slack periods should be introduced. Peak periods should be met with hired labour and by utilizing labour saving devices that are feasible and economical. While the profitableness of various enterprises should always be kept in mind, it should not be the sole determining factor. Other factors such as maintenance of productivity, distribution of income, availability of capital, proper utilization of machinery and buildings, risk involved, and the use of by-products should be taken into account; and this might necessitate including crops which do not give a high money return. It is well to remember that the best combination of enterprises depends on *all* these factors and therefore a general rule cannot be made. A combination which is best for one farm under one set of conditions may be totally unfit for another farm under another set of conditions. The problem therefore, like many other problems in farm management, is one of adaptation.

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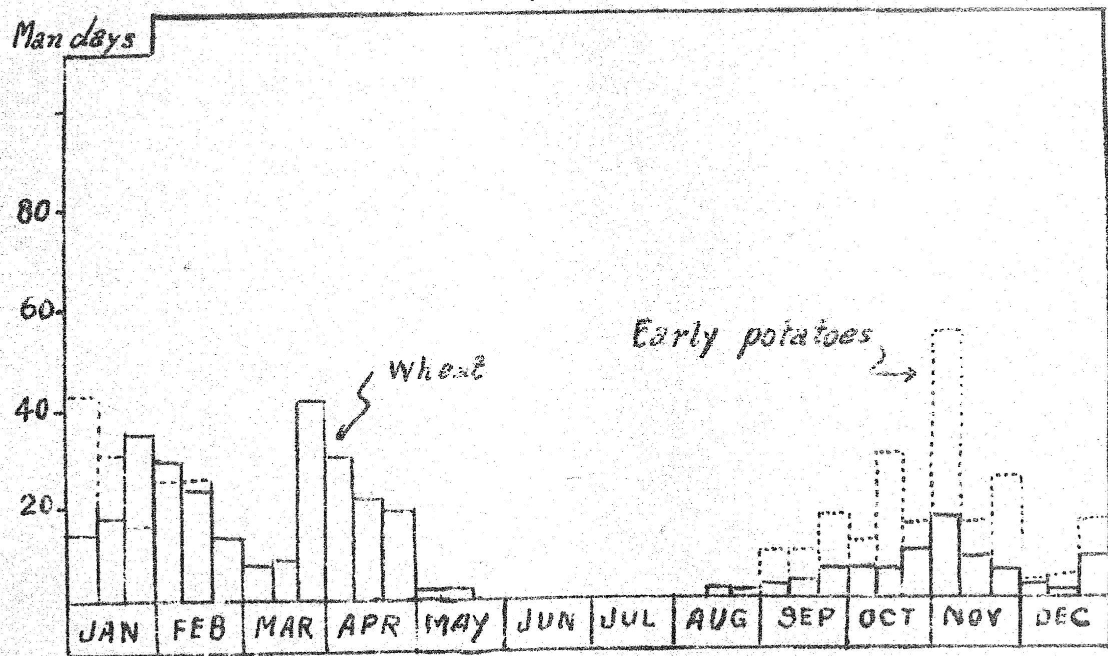
Figure 10. Distribution of Man Labour on Wheat and Early potatoes per 5 acres by 10 day periods in Allahabad.



The critical periods for both wheat and early potatoes accur at the same time.

A NEW METHOD OF HARVESTING "HILL" POTATOES.

By

G. D. Singh and M. Vaugh.

The Agricultural Institute has for many years carried on investigations to find ways of easing the work of the farmer, as well as trying to increase the output of work per man without increasing the physical effort. It has been recognised that there are certain seasons in the year when there is a rush of work, too few people to get everything done in time, and loss results if the work is delayed.

It has been realised that the most effective means of increasing the out-turn of work per labourer is the increased use of non-human power and the use of better implements and equipment. In view of the smallness of the average holding and the large number of cattle available, special attention has been given to the use of small animal—drawn implements and to the selection of implements which could be used for the maximum number of operations through the year, and for the maximum number of days.

One of the operations which has been troublesome is the harvesting of potatoes. The "hill" or late potatoes have to be harvested at the same time as the rabi small grains are harvested, when there is an acute shortage of labour. At this time the weather gets hotter rapidly and if not harvested promptly the potatoes rot in the ground. Rapid drying of the soil increases the difficulty of digging the potatoes; irrigation is not only an added expense but undesirable for the keeping quality of the crop. The common method of harvesting with the *khurpi* results in a considerable number of cut and bruised tubers which adversely affect the keeping quality of the others.

An even greater scarcity of labour in the last season led to an attempt to use the ordinary cultivator for this work. We have found that the "bullock hoe" or small animal drawn cultivator is useful for many operations and the combination of a small cultivator and a small improved plow makes a suitable basic set of improved implements for the small holding. If it could be applied to this work, an additional use would be found for it, at a time when it was not required for other work, leading to increased annual use and reduced annual cost.

The work was organised as follows:—The cultivator was worked by two men, one to drive the bullocks and the other

to hold the cultivator. The potatoes had been planted in long continuous rows, the vines of the crop were dead and there were not many weeds. Labourers were distributed along the length of the rows. The cultivator was driven along the row, digging it up, and making two passes on each row. The labourers gathered up the potatoes that appeared on the surface. When the potatoes which had been exposed had been gathered, the cultivator made a third trip along the row to again stir the soil and expose additional tubers not exposed the first times. Adjacent rows were not worked consecutively but the work was arranged so that the second gathering in one row was done along with the first in the adjoining row so there was little loss of time. As is usually true, the new method was not at first favoured by the workpeople, especially those who were considered skilled labourers on harvesting. A few days work however, won a greater measure of approval than is usually given a new way.

After the work people had become somewhat accustomed to the procedure and the difficulties straightened out a bit, a measured trial was made on April 1, 1947, to compare the new method with harvesting by hand. The test was conducted between 6-30 and 11-00 A.M. in field No. 16 of the Institute farm. The soil was a sandy loam, had been irrigated the last time 15 days before and was semi-dry but not cloddy. The calculations were based on the following data :—

With the Cultivator.				By Hand (*khurpi*)
2 skilled workmen (baildars) at Rs. ..	1	4	0 per day.	
11 children at Re. ..	0	8	0	6 experienced women at Re. 0-12-0
1 cultivator at Re. ..	0	1	0	
1 pair of bullocks at Rs.	4	0	0	Calculations are based on 9 hours per day working.

The following results were secured in the trial :—

	With the Cultivator	By Hand (*khurpi.*)
Out turn during test	55 mds. 5 sr.	9 mds., 15 srs.
Out turn per worker per day, 9 hrs	7 mds., 25 sr.	2 mds, 25 srs.
Labourers required to harvest one acre per day of 9 hours ..	13	37
Cost per md. harvested in trial ..	0 2 0	0 4 3
Damaged tubers per md. harvested	1 sr., 8 ch.	5 srs., 6 ch.
Tubers left in the field per acre* ..	35 srs., 10 ch.	20 srs., 10 ch.

* Tubers left in the field was determined by gathering up the tubers exposed during subsequent plowing and preparation of the field for other crop to follow. It should be noted that the people harvesting by hand were "skilled," old hands, and in competition with a new method. They were adults, while many of the labourers with the cultivator were small children.

11 labourers to gather the potatoes were not enough to fully occupy the bullocks. On large scale operations, either more laborers to gather up the potatoes or use of the bullocks for only part time would further reduce the cost per acre. In the case of the small cultivator, where the bullocks would otherwise be idle, it would be definitely desirable to use them, even if the ratio of laborers to bullocks were even less than that in the above test. Probably 15 pickers to 1 pair of bullocks is desirable.

It will be noted from the table that on every count but one, the harvesting by the use of the cultivator is better. More tubers were left in the field by 15 srs. This is partly ofset by 3 srs., 14 ch., fewer cut potatoes. If the potatoes are stored for only a short time before being marketed, the reduced loss from rotting is likely to more than balance the 10 srs. per acre left in the field. At the comparatively high price of 0-4-0 per seer, the 10 srs. would be worth Rs. 2-8-0. On the comparatively low yield of 100 mds. per acre, the saving of Re. 0-2-3 per md. in harvesting cost would amount to Rs. 14-1-0 per acre, leaving a net profit of Rs. 11-9-0 after allowing for the value of the potatoes. The saving on 4 to 5 acres would pay for a cultivator.

While the above is based on tests on only one field, and while the results need to be checked by trials under other soil and moisture conditions, the results are sufficiently striking to seem to justify publishing them for information. It should be noted that the same cultivator can be used for planting and interculture operations with similar savings over hand labour. These methods have been practised at the Institute for a number of years and are well established.

These particular tests were planned and carried out entirely by Mr. Singh. Mr. Vaugh has helped only in the general development of the use of the implements and in preparing the report.

THE COMMERCIAL DAIRY COW*.

By

T. W. Millen,

Head, Department of Animal Husbandry and Dairying, Allahabad Agricultural Institute.

Many dairies are being started all over India to increase the inadequate supply of milk. Most of these are sponsored by men who hope to secure financial benefit from their venture. Also people who have never kept cattle before are now maintaining enough cows and buffaloes to supply the milk needed in their own households. In this article an attempt is made to point out some of the factors which will determine whether the venture is economically sound or not.

Buffaloes versus cows.

We cannot recommend the keeping of buffaloes from our experience at the Agricultural Institute. Although we have good registered Murrah buffaloes from a fine stock, and lactations of 5,000 pounds or more of milk are not uncommon, still the buffalo is a large animal and takes a rest for several months on alternate years. Our buffalo herd just pays for its feed. We admit that 95 per cent. of the milk sold in some of the cities of India is buffalo milk and few productive cows are found in the villages yet we would not attempt to run a commercial dairy with many buffaloes in the herd.

What cows to keep.

There are several breeds of Zebu cattle that have produced individuals yielding adequate quantities of milk. The Indian Council of Agricultural Research maintains herd registers for the Sahiwal, Red Sindhi, Hariana, Gir, and Kankrej breeds. Herd books are proposed for the Ongole and Tharparkar also. We have chosen the Red Sindhi but recognize the possibilities of the other breeds. We feel that the foundation stock for a commercial dairy should be of the best individuals available in one of these breeds.

We cannot advise anyone to keep *desi* cows, no matter how cheaply they are purchased, for sooner or later they will become a burden. The prevalent method of buying fresh cows, milking them till they no longer pay for their feed and then disposing them of is not a good practice. The stock in the

*Reprinted from Indian Farming, Vol. VIII, No. 1, Jan. 1947.

country becomes depleted, and when restrictions are enforced in the producing areas, great hardship is experienced. The best way to maintain a good herd is to start with the best animals obtainable and to improve it by selective breeding; raising most if not all of the needed replacements.

The herd sire.

Unless the breeding bull is better than the average of the cows, the herd will deteriorate rather than improve. If possible his female ancestors should yield at least $1\frac{1}{2}$ times the herd average. A bull that has sired productive daughters should be kept when obtainable.

Cross-breeding.

The present Zebu breeds are not uniform in conformity or performance. The best yielding cows may have useless daughters. It will take decades to develop a herd in which all the females produced will be economical yielders. For quick results foreign dairy bulls may be used on Zebu stock. The crossbred females will usually be the money makers. There is at present in India an almost universal prejudice against cross-breeding. Careful enquiry reveals that this prejudice is not based on practical experience but hearsay.

The military dairies have used Holstein-Friesian crosses in their dairies and have often graded up Zebu stock to 31/32 or more Holstein-Friesian. These military dairies also maintain a high proportion of buffaloes in their herds so that the mixed milk is acceptable to the army personnel after 'toning' it to the legal butter fat content. For large milk yields the Holstein-Friesian crossed on the Sahiwal would be a good combination. We, however, are interested in keeping a smaller cow giving richer milk. The Jersey-Sindhi gives us an animal, about three-fourths the size of the Holstein-Friesian × Sahiwal, which yields rich milk in profitable amounts.

Another advantage of the Jersey × Sindhi cross is that a herd of uniform colour can be maintained if the Jersey sire is dark fawn and the Red Sindhi cows are homozygous red. Both breeds have black muzzles, switches and eyelids and the dark fawn blends well with the Sindhi red.

The long-time policy.

Many worry about the next generation and ask about the F_2. We do not recommend the interbreeding of crossbreds. We would use only purebred sires except for the first cross when a crossbred bull could be used on pure Zebu cows. We

have been able to fix increased milk production in cows graded back to the Red Sindhi until only $\frac{1}{16}$th of the Jersey blood remained. We do cull out some of the $\frac{1}{4}$, and $\frac{1}{8}$ Jerseys but fewer of these were unprofitable than were their Sindhi mothers. We used the Jersey bull on only Sindhi cows giving less than 2,000 pounds per lactation, and produced daughters yielding $2\frac{1}{2}$ to 3 times this amount.

What is a profitable yield.

A number of factors enter into the calculation of profits and losses in the dairy business. Twenty years ago a committee at the Institute agreed that a cow should produce 2,050 pounds of milk to pay for her feed. Figures are not available to show how this was determined but under present conditions a cow giving 2,000 pounds of milk per year would just pay her expenses.

The following figures are based on the actual feed costs and production records of the cows in our herd during the year 1945. We credited the cows with 2 as. for each pound of milk produced. This is considered a wholesale rate allowing a margin for retail costs. The cows were fed roughage at the rate of 10 lb. green basis per 100 pounds of body weight and the average cow weighed about 750 lb. They were given concentrate mixture according to their age, condition and production. This amounted to $1\frac{1}{2}$ to $2\frac{1}{2}$ lb. per cow for maintenance and 1 lb. for every three pounds of milk produced. The fodder changed in type as did also the concentrate mixture as the season changed or certain feed stuffs became unavailable. Dry fodder was fed at the rate of one pound for three pounds of green feed and silage at the rate of two pounds for three pounds of green feed.

Chaffed green feed was given daily along with *jowar* and *bajra* silage, chopped stover or wheat straw. This green roughage consisted primarily of napier grass, cowpeas, lucerne, guinea grass, sunflower, fodder raddish and mixed field grasses. Green fodder cost approximately 12 as. per maund, the silage 9 as. per maund and the concenrate mixture Rs. 4-8-4 per maund[1]. All the cows were stall-fed or, if dry, fed in mangers in the paddock. The concentrate mixture contained minerals and plenty of fresh water was provided.

Our labour, water, veterinary and miscellaneous charges for our herd of 170 dairy animals averaged about Rs. 44 per cow in addition to the feed charges. We kept a herd book

[1] Present concentrate rates are about 50 per cent. higher.

in which the monthly feed cost and production records were recorded. We found that a cow yielding 1,465 lb. of milk just paid for her feed. One giving 2,000 lb. would pay for her feed and other expenses but give us no profit. Table I shows the average values for cows in our herd last year.

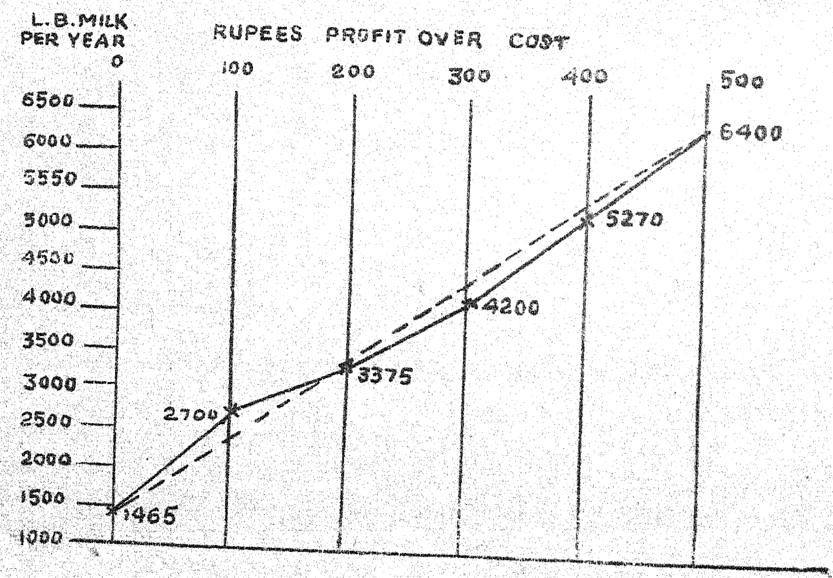
TABLE I.

Value of milk over feed cost and annual location

Value of milk over feed cost in Rupees	Annual pactation in pounds
Nil	1,465
100	2,700
200	3,375
300	4,200
400	5,270
500	6,400

These figures almost make a straight line when plotted on a graph. From this profits for other yields can be easily determined.

During our financial year (April 1, 1945 to March 31, 1946), 18 Red Sindhi cows completed their lactations averaging 3,005 lb. of milk in 308 days with 214·8 days dry preceding this lactation for 14 of them, four being first lactation heifers. This 5·75 lb. overall daily average would give an annual yield of 2,096 lb. and an average of about ten rupees per cow over her feed and other costs. The 14 Jersey-Sindhi cows completing their lactations yielded an average of 5,160·6 lb. in 377·8 days with 60·4 days dry for 13 cows. One was a first lactation heifer.



In this case the overall average is 11·78 lb. daily with an annual yield of 4,299·7 lb. Here both the higher lactation yield and the shorter dry period count. These cows gave about Rs. 270 each over feed, labour and miscellaneous costs. It would take 27 of the Red Sindhis to give the same profit over feed cost as one cross-bred.

The comparative investment.

In these calculations we have not taken into account interest on the investment or replacement charges. The cows will average possibly six lactations if well cared for, so one-sixth of her purchase price must be deducted from the profit earned by each cow per year for the first six years. On the other hand, we must credit the cow with about Rs. 60 for the manure produced during the year if it is used efficiently as fertilizer or sold as fuel cakes in a good market.

What does a cow cost?

Cattle prices are determined by supply and demand. Individual quality is an important factor. We sold two cows during the past year for Rs. 900 each and a number at Rs. 850 each. Cows purchased by us cost a little over Rs. 750 each when we allowed credit for the accompanying calves. Home-raised heifers were a little cheaper, 67 first lactation heifers taken into the herd last year costing about Rs. 640 each.

Calves now being raised will be more expensive owing to increased labour and feed prices. In all our calculations we have considered the cow's feed only and her full production. The calf is weaned at birth and raised separately as a capital item or discarded.

The commercial dairy cow.

A cow to be commercially profitable in our dairy should yield a minimum of 3,250 lb. of milk per year.

Cost of cow Rs. 759.

ASSETS—1.	Profit of milk (8 lb. per rupee) over feed cost ..	Rs. 184
2.	Manure value	Rs. 60
	Total ..	Rs. 244
DEBIT—1.	Annual replacement depreciation ..	Rs. 125
2.	10 per cent. profit on investment ..	Rs. 75
3.	Labour and miscellaneous charges ..	Rs. 44
	Total ..	Rs. 244

Our best cow last year gave an annual yield of 6,870·8 lb. leaving Rs. 433 for our profit on our investment. The best registered Red Sindhi (Birquee Registration No. 0407 in her first lactation) gave an annual yield of 5,448·3 lb., with Rs. 335 profit on the investment. In our herd 65 cows gave from 10 to 58 per cent. on our investment last year. Commercial dairies are possible in India. We have one.

IMPROVING THE MILK SUPPLY OF TOWNS*

BY

ZAL R. KOTHAVALLA, B.Ag. Ani. Hus. (Bom.) B.Sc. (Agri.) (Edin.), N.D.D. (Scot.), D. Sc.

Dairy Development Adviser to Government of India.

In dealing with the problem of milk supply in India, the vital distinction between increasing the milk supply of a town or a particular urban area and of a province or the country as a whole is to be recognized. The former, unlike the latter, can be achieved in comparatively short time by adopting measures such as are proposed to be discussed at some length in this note. These measures aim at making the milk produced in areas surrounding the town available to it instead of the milk being converted into products, as at present.

The improvement in the existing milk supply of a town can broadly speaking be brought about by (i) augmenting the existing milk supply by developing new sources, to enable the supply to cope with the demand, and ii) reorganizing the existing system of control and supervision of the milk supply to the town.

The present high level of prices of milk and milk products in town is mainly due to the fact that supply is not able to cope with the demand. The first step to be taken, therefore, is to find out ways and means of augmenting the existing supply. What these should be would depend on the location of the town and its surroundings. The present system of producing milk by housing cattle in the heart of the town has been universal in the country and has been found to be most uneconomical and unhygienic, besides leading to the gradual destruction of the valuable cattle wealth of the country. Any new method adopted should, therefore, aim at abolishing these stables and for that reason the source for the increased supply of milk would have to be looked for from areas outside the towns. This source may be (i) organization of milk supply from areas surrounding the town, (ii) establishment of creameries in milk-producing areas, and (iii) establishment of dairy farms.

Organization of milk supply from areas surrounding the town will divide itself under two heads: (a) Milk supply from villages lying adjacent to the towns or what may be called 'inner belt'—extending up to a radius of about 15 miles of

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*Reprinted from Indian Farming, Vol. VII, No. 10, October, 1946.

the town, and (b) milk supply from villages lying beyond this radius and extending up to 50 miles, which may be called the 'outer belt.' Of the two, it is desirable that the organization of the milk supply from the 'outer belt' should be taken up first because that will help in actually augmenting the milk supply without disturbing the present supply as the milk is already being brought by various means to the town from the 'inner belt.'

The inner belt.

Many of the towns in India where shortage of milk is felt at present are fortunately surrounded by areas which form potential sources of supply of milk. Almost every town, whether small or large, derives nearly 50 per cent. of its milk requirements through what are called 'milk carriers.' The milk collected by them from the villages is carried on cycles or head loads and distributed direct to individual customers. Their range of work extends even up to 12 miles radius from the town. For some of the larger towns like Bombay, Madras, Calcutta, etc. which are well-provided with local trains, milk is brought from even greater distances by these carriers. This is one of the most important agencies in the milk supply to towns and one which presents great possibilities of improvement. The sources of supply of milk in this system also lend themselves for further increased production. Some of the measures which can be adopted for this purpose are :

(i) To organize the producers on cooperative lines and arrange for them to deal direct with the consumers themselves, to the mutual advantage of both, by doing away with the middlemen or the carriers.

(ii) To organize the carriers themselves on cooperative lines by giving them facilities of a central milk collecting depot or depots from which milk can be economically distributed collectively, instead of each individual carrier going round the delivery. This will ensure a greater uniformity of method and fewer distributing agencies, consequently less supervision and control by the authorities concerned.

(iii) To open depots for cattle feeds in the producing areas and subsidizing the supply, if necessary.

(iv) To provide milk supply cans of suitable types and at a concession rate, as also cycle tyres, tubes, etc. which are very difficult to obtain at present.

(v) In the case of carriers bringing milk by local trains, allowing them concessions in the freight and providing a

special carriage or compartment where milk can be put in a clean place during transit.

(vi) For the municipalities to provide special depots well distributed in the town, from where milk can be distributed to the areas apportioned to each set of carriers.

(vii) To give loans to the organized small producers for purchasing cattle and feeding stuffs to effectively increase the production of milk in the zone surrounding the towns. It has been found from experience that by proper feeding and maintenance the milk yield of a village cow can be increased even up to 50 per cent.

The outer belt.

The organization to be set up for the purpose should aim at organizing the producers, the collection of the milk from them and its rapid transport to a suitable centre where it can be processed and distributed through a reliable agency or agencies, so that the quality of the milk is assured and it is sold at a reasonable price to the consumers. Such an organized effort calls for the following:

(i) *Survey:* A rapid survey of the areas is necessary in order to ascertain firstly the quantity of milk available for collection after allowing for the domestic need of the producers and the wide fluctuations for the different seasons which invariably occur under village conditions, and secondly the disposal of surplus milk and the scope for developing this source. Such a survey can be satisfactorily carried out in two to three months by employing adequate temporary staff, but this will require expert guidance.

(ii) *Organizing the producers:* This will have to be undertaken, preferable on cooperative lines, based on the data obtained in the survey of the area, so that those villages or centres which produce sufficient quantities of milk which can be handled economically, need only be considered in the earlier stages. It will be desirable to attempt to centralize the milking in the villages right from the beginning and in order to provide an inducement for the purpose to the villagers, each village should be provided with a small milking shed with facilities of water supply, etc. the cost involved being partly or wholly borne by the Government.

(iii) *Collection of milk:* This should be done at centres which are so situated that the collection of milk may be done as expeditiously and economically as possible.

(iv) *Rapid transport of milk:* Quick haulage of milk to its destination soon after production is very essential as the time factor is most important with such a highly perishable food as milk. The haulage can be done either by rail or road, but in a majority of cases it will have to be done by the latter, in which case motor transport will have to be employed. Motor lorries for this purpose will be required.

(v) *Processing of milk:* As milk will be collected from various sources and produced under insanitary village conditions and as some time must elapse before it is made available to the consumers it will have to be processed (heated or chilled or both, *i.e.* pasteurized) and for this a processing centre or pasteurizing station will have to be established, preferably in the consuming town itself, with facilities of cold storage, etc. so that the distribution of milk can be regulated according to the requirements of the consumers irrespective of the time of milking in the villages.

(vi) *Distribution depots:* The milk collected and processed as above can then be distributed to the consumers over the counter through depots specially provided for the purpose, where milk of guaranteed quality can be made available to the public. It is not considered feasible in earlier stages to attempt house to house delivery of milk, particularly in view of the shortage of containers and bottles.

(vii) *Supply of cattle feeds:* As a necessary adjunct to such a system of milk collection and supply, arrangements will have to be made to supply cattle feeds such as oilcakes, bran, chunni, etc. to the village milk producers so as to give them an incentive for producing more and better quality milk. In some cases this idea of helping the villager can be further developed by arranging for the supply of his daily requirements such as kerosene oil, sugar, cloth, etc., against deliveries of milk.

Cooperative working.

The schemes as outlined above by virtue of its special features of collective working may preferably be run on cooperative lines under the aegis of Cooperative Department of the province.

Conditions governing the selection of a town for the scheme and the pre-requisites to the successful adoption of a scheme of this nature will be as follows :

(a) That the town selected for the supply of milk is surrounded by milk-producing villages or centres lying within 15 to 50 miles of it and the quantity of milk produced by such centres should be sufficient to make its collection, haulage, handling and distribution economic on a consideration of working costs. In the light of the experience gained so far it may be stated that each such village or centre should on an average be able to supply a minimum quantity of $2\frac{1}{2}$ maunds of milk a day.

(b) That the majority of villages to be tapped should lie as far as possible along side the roads to be traversed or at a distance not exceeding 2 to 3 miles from the road, as it is necessary to collect the milk rapidly for transporting it to its destination.

(c) That the area is well-provided with roads which will permit of the haulage of milk by motor transport in all seasons of the year.

(d) That the producers must be assured of the market for their milk throughout the year at a predetermined price and the milk must be paid for periodically, as ready cash is the greatest need of every stock-owner.

Establishment of creameries.

A scheme for establishment of creameries in milk-producing areas in the provinces may or may not be found feasible for all towns or urban areas. The location of some of the towns, which are generally of a large size like Bombay, Calcutta, Madras, etc. would permit of the additional collection of milk being drawn only from sources placed far away from them and which would involve long-distance transport of milk by rail, after processing it at the collecting end itself. Such sources of supply generally are to be found in every province and which at present are not fully exploited for the supply of milk in liquid form. The organization to be set up for obtaining milk from these areas would consist of the following :

(i) Establishing a creamery or milk-collecting and processing centre in the milk-producing area itself.

(ii) The transport of milk so processed by rail and in refrigerating vans over distances ranging from 50 to 300 miles.

(iii) Establishing a milk-distributing organization in the city itself with sufficient cold storage facilities.

The extra overhead charges involved in a system of milk supply of this kind will be more than compensated for by the low price at which milk can be purchased in these milk-producing tracts. To make the working of such a creamery economically possible it should be in a position to receive and process at least about 6,000 to 8,000 lb. of milk a day, but this quantity would vary from place to place according to circumstances. The whole of this organization can be run either by a Government agency or through private enterprise which may be subsidized. It will, however, be possible to build village milk-producing societies round about such creameries and in course of time they may be run on cooperative lines.

Establishment of dairy farms.

Experience has shown that milk obtained from villages fluctuates widely in quantity according to seasons and that it is at its lowest in summer. Since the supply of milk to the consumers must be constant and assured throughout the year, in order to counteract the above drawbacks there should be another and more dependable source of supply of milk for the town. This should be in the form of a dairy farm or farms established as near to the town as possible either by Government or through private enterprise. In the latter case a subsidy may be provided in some form or another preferably by the payment of a certain amount per pound or maund of milk of a guaranteed quality delivered to the town. Such farm or farms should be producing at least 25 per cent. of the quantity of milk obtained under the village system to meet the deficit during the scarcity period. The following facilities may be needed to establish and encourage such a supply.

(i) Facilities of land and grazing.

(ii) Provision of irrigation water for the cultivation of fodder crops at a concession rate.

(iii) Concession in railway freight with the facility of refrigerating vans.

(iv) Provision of necessary equipment for the dairy, etc. under priority.

(v) Providing subsidy to enable the farm-produced milk to be sold in the consuming areas at controlled rates.

Control and supervision.

Reorganization of the existing system of control and supervision of the milk supply to the town is of supreme importance. No matter how carefully the agencies for the

increased milk supply at a place are arranged they will not stand a fair chance of surviving unless these are effectively protected against unfair competition from the trade, both in respect of price as well as quality. This calls for proper control and supervision over the supply. One of the greatest handicaps in the proper supervision and control of the milk supply of a town is the existence of the innumerable agencies or channels through which milk is made to pass during its handling and distribution in a town. This also hinders the development of the dairy trade on right lines. The reorganization of the present system of milk supply calls for definite measures to be taken. They may be summed up as follows :

(a) *Creation of a milk supply organization :* Adoption of measures which would ensure adequate milk supply on the lines indicated above should provide such an organization for obtaining milk from reliable sources. Such an organized effort will enable the milk supplying agencies to be reduced to a few selected ones and this will call for the divisions of the milk-producing areas into zones, so that a zone may be assigned to a particular agency to prevent the various selected agencies from competing with one another unfairly.

(b) *Creation of milk procurement and distribution organization :* This is necessary for replacing the innumerable individuals employed in distributing milk, by a few selected agencies. As in the case of (*a*) above, the area of trading in the town will also have to be zoned out, so that each agency is allotted a zone to prevent unfair competition.

(c) *Removal of cattle stables from urban areas :* As more and more milk is imported in the town from the rural areas through an organized effort, the city milch cattle stable will have to be removed. Their removal will call for (i) the prevention of the return to the city of cattle salvaged from the stables when they come into calf again and (ii) the absorption or colonization of the replaced animals from the city at centres away from the town from where milk could be easily obtained for the town.

(d) *Adoption of an effective system of licensing and supervision :* The introduction of a complete and effective system of licensing of the trade with suitable standards for quality and an adequate and efficient staff for enforcing supervision and the standards of quality will be a necessary adjunct to such a reorganization.

(e) *Appointment of a milk control board:* Such a board may be for the province or the State as a whole or for the town in the first instance, where the improved milk supply scheme is to be worked. Experience in the past has shown that efforts made at reorganizing the milk supply of a town were always too much diffused and there was no cooperation between the man in the trade and the controlling authorities in improving matters. It is, therefore, felt that there should be a central independent body which should coordinate the activities coming under the reorganization of the milk supply of a town. It is suggested that a milk control board should be created. Such a board should be constituted of a limited number of members, not exceeding seven, representing government, municipality, producers, traders and consumers. Its primary functions should be the following:

(i) To safeguard the interests of the producers, traders and consumers.

(ii) To periodically fix the purchase as well as the sale prices of milk for that area.

(iii) To control the marketing and distribution of milk according to the needs of the different classes of consumers.

(iv) To control the production of milk and milk products in a consuming area as well as in areas adjoining it.

(v) To fix standards of quality of milk and milk products sold in that area.

(vi) To act in an advisory capacity in matters relating to the policy to be followed and measures to be adopted for the development of the milk trade.

Technical guidance.

Whatever be the type of scheme adopted by the provinces or States for improving the milk supply of a town, technical help and guidance will be needed to solve the difficulties which are bound to arise at every stage with the commencement of the scheme. The prerequisite for the success of such a venture will be the provision of adequate technical staff. No doubt expert help and guidance will always be made available from the Centre but the Provincial Governments shall have to maintain staff of their own to be on the spot. The strength of the staff required will depend on the amount of dairy development work undertaken by the province concerned. Since

this kind of work will require qualifications and experience of a high order, the pay and status of the posts to be created should be such as to attract men of the right type who could command the confidence of the trade.

Urgent steps.

This note has been drawn up with the idea that it will suggest to the provinces and the States the various ways and means which are possible to adopt for improving the milk supply of a town. The steps which should be taken to achieve this are briefly indicated below:

(*a*) Appointment of technical staff.

(*b*) Starting of surveys of (i) the potential milk-supplying areas to determine to what extent each area can be depended upon to supply the needs of the towns and for organizing the supply from that area whether on cooperative lines or by the establisment of creameries or milk processing centres, (ii) sites suitable for establishing large-scale dairy farms so that the milk supply from the rural areas can be supplemented by milk obtained from reliable sources, and (iii) urban areas or towns where the reorganization of the milk supply is proposed to be introduced. In the latter connection it must be remembered firstly that instead of large cities where the problems are too numerous and complicated it may be desirable to select a few small towns to begin with where a more complete model scheme on an experimental basis may be tried out. Secondly the town or area where the shortage is most acute should be tackled first, both for production and distribution and thirdly, the total requirements of a town or area selected may not be met all at once but it may be feasible to mitigate conditions on a progressive and limited scale to begin with.

(*c*) Establishment of a milk control board and the creation of an organization for the production of milk and another for the procurement and distribution of milk based on the surveys carried out.

"POLYEMBRYONY AND HORTICULTURE."

By

DURGA DAS SRIVASTAVA, B.Sc., (Ag.)

Polyembryony refers to the occurrence of two or more embryos in one seed. It is of frequent occurrence in the gymnosperms as compared to the angiosperms. The phenomenon has been frequently noticed in wheat, oats, rye, sugarcane etc. The seed upon germination produces two plumules and a single seed may give rise to two or more seedlings. However, advancement of our knowledge of polyembryony has been rather slow as compared to the progress made in other botanical fields. In fact some people are of the opinion that adventitious embryos are malformations.

Leeuwenhoek in 1719 found orange seeds each containing two embryos.

Strasburger in 1878 considered polyembryony as a gradual change from the normal formation of the sexually produced embryo as the result of weakening of sexuality of the pollen formation and the capacity of the embryo to develop.

Pfeffer considered it as a form of budding.

Ganong suggested that it may be the early stages in the development of something new.

Ernst in 1901 summarised the literature dealing with polyembryony and classified various means by which adventitious embryos may be derived.

Another popular belief is that polyembryony is a primitive feature of the angiosperms, the number having got reduced in the interest of a strong embryo.

For the proper understanding of polyembryony one must know the development of the embryo. A mature ovule consists of a stalk, nucellus, embryo sac within the nucellus, two integuments and the micropyle. Before the integuments appear one nucellar cell near the apex enlarges to form the archesporial cell. This divides and gives rise to the megasporocyte and the tapetal cell. These cells divide and give rise to the megaspores and the tapetum respectively. The lowest megaspore is usually functional and gives rise to the embryo sac. The nucleus of the megaspore divides to form eight nuclei. Three nuclei at the base form antipodal cells while of the three at the upper half one forms the egg cell

and the other two, synergids. The remaining nuclei come to the centre and fuse to form the endosperm nucleus. A sperm nucleus from the pollen tube fertilizes the egg nucleus. Gradually the egg nucleus divides and the embryo sac enlarges rapidly destroying many cells of the nucellus. Ultimately embryo sac is completely filled with the endosperm and nucellar tissue is nearly all destroyed. This is in brief the development of the embryo and endosperm.

Types of Polyembryony.

1. Sporophytic polyembryony. In this, adventitious embryos are derived from Sporophytic budding from the (a) nucellus (b) Integument.

Nucellus—Nucellar polyembryony is noticed in Citrus, Fortunella, (Rutaceae), mango (Anacardaceae) Potentilla, Eugenia, Alnus, Zanthoxylum, Aegle, etc.

Integument—Eugenia and Potentilla.

The production of sporophytic embryos begins soon after flowering in enlarged cells of the integument or nucellus. These cells grow and divide and project into the embryo sac and then develop into one or several embryos. Thus there ensues a competition between the gametic and the apogamic embryos. Opinions differ whether the formation of such embryos is stimulated by pollination and fertilization.

Nucellar embryos develop asexually by ordinary mitotic division of the cells of the nucellus. No male cell contributes to their formation. Nucellar seedlings are also identical. For the iniliation of the development of the nucellar embryos pollination is usually but not invariably necessary. It is possible that pollination is also associated with the supplying of hormones. It has been found that nucellar embryos begin to develop some time after fertilization, thereby showing that fertilization is also necessary for the initiation of the development of such embryos. Webber states "Though not positively demonstrated it is possible that some Citrus species may develop nucellar embryos without pollination."

Because nucellar embryos are produced asexually and without reduction division any genetic difference between the offspring is in the nature of a somatic variation, the change having occured in some somatic cell or cells. The nucellar variant seedlings are very similar to bud variation types.

The detection of the nucellar seedlings is not very easy. Hybrid seedlings can be recognised when they are a few months old. However, some chemical tests have been tried to distinguish hybrid and nucellar seedlings.

For the control of nucellar embryony it is suggested that the trees of plants be shaded partially and by occasionally reducing the foliage. Thus the average number of extra seedlings could be reduced by 50-100 %.

Mature seeds may have 10—15 recognisable embryos. However, the number of embryos capable of germination rarely exceeds 3 or 4. Even in one species, varieties differ greatly in the average number of nucellar embryos.

The young nucellar seedling is often thorny but has more of vegetative vigour. The nucellar seedlings also have less tendency to blooming as compared to budded and gratted trees of the same age.

Under certain conditions, for example low night temperatures in the blooming season, various diploid varieties sometimes produce tetraploid nucellar seedlings, and these when crossed with the diploids give rise to triploids, most of which are not very productive.

One of the great disadvantages of nucellar embryony is that in the early stages it is often difficult to distinguish hybrids and nucellar seedlings which is a considerable handicap in a breeding programme. Hybrids and nucellar trees have to be grown until the time of flowering and fruiting, thereby involving a considerable expense.

Nucellar embryony is noticeable in a number of varieties of citrus and also in Fortunella and Poncirus.

II. Cleavage Polyembryony.

This is accomplished by the separation of the zygote or young embryo into two or more units each of which develops into a separate embryo. Cleavage polyembryony has recently been reported from a number of gymosperms. It is rather rare in the angiosperms. It has been observed in the Loranthus, Lobelia, etc.

III. Simple Polyembryony.

Simple polyembryony may be due to the characteristic formation of a plurality of eggs, with the megaspore, and the union of these eggs with the sperms. A plurality of sperms

is produced from the one to several microspores which germinate within the micropyle, just opposite the point where the eggs are borne.

Following amphimixis several independent embryos develop within the embroy sac. A plurality of eggs of sperms is not very common of the Angiosperms; therefore, it is doubtful if simple polyembryony is of importance in the group.

Simple polyembryony is reported in some of the angiosperms, but it is probable that in those cases the extra embryos might have been derived from the synergids.

Similarly adventitious embryos may also be formed from the antipodal cells.

IV. Euploid Polyembryony.

Under euploid polyembryony we have multiple embryos which give rise to haploids as well as polyploids. Hyper and hypoploids are also included.

Ramaih in 1933 found twin plants in rice, one with haploid and the other with diploid chromoseme number. Euploid twining has been reported in a number of cases *e.g.* haploid-haploid in Gossypium, haploid-diploid in Triticum and haploid-hriploid in Phleum. However, the diploid-diploid twins are the most common.

Triplets are also reported in several cases.

The fact that triploids occur more frequently than haploids in conjunction with diploids led to the belief thta triploids develop from the endosperm. During megosporogenesis in the angiosperms the two haploid polar nuclei are formed which fuse to produce the endosperm nucleus. After union of the latter nucleus with a male nucleous a normal triploid endosperm develops.

In the case of rice the twin seedlings, one of which was green and the other albino, led Ramaih and his colleagues to conclude that the twins were derived from 2 embryosacs.

Muntzing from a comprehensive study of euploid twins concluded that occasionally two embryosac mother cells are formed.

V-Unclassified Cases of Polyembryony.

The occurence of polyembryony is not always a simple process; thus it has been found that two embryo sacs may

develop in the same ovule and in each of these sacs several embryos may mature. In Allium for instance 5 embryos are found in a single embryo sac. One of these is normal, one from the synergid, two from the antipodal cells, and another one from the integument.

True and False polyembryony.

Polyembryony, as we know, is defined as the production of two or more embryos within an ovule.

True polyembryony is the production of plural embryos within a single embryo sac.

False polyembryony is the production of plural embryos derived from several embryo sacs.

The nucellus influences the developing embryos, therefore it is supposed that multiple embryos formed within the same nucellus are cases of true polyembryony, and false polyembryony would be limited to those cases in which multiple embryos are derived from different nucelli. These different nucelli may be derived from more than one ovule developing in a normally one ovulated seed-like structure and the fusion of the ovules. This is false polyembryony as the embroys are derived from different ovules.

Frequency of polyembryony and the developmental competition of plural embryos.

It is well known that polyembryony is more common in some species, varieties, and strains, than in others. In the angiosperms the average number of seedlings per seed is about 2—6.

Polyembryony in the Gymnosperms is very prevalent and in some conifers a single ovule may have as many as 200 potential embryos.

In certain varieties of Citrus and Mangifera nearly every seed is polyembryonate and as many as 30 embryos have been observed in a single seed. In Citrus the average number varies from 1—6·5. Thus in the lemons the average number of embryos per seed has been found to be 2·15. Several grape fruit varieties produce many nucellar embryos. The pummelo is supposed to be monoembryonate.

The number of embroys in some of the other genera *e. g.*, Eugenia and Hiptage have 1—20 and 1—7 respectively.

In the Murraya a single sporophytic embryo with the gametic embryo occurs about once in 120 seeds.

The actual freqnency of polyembryony is usually indicated only by the relative occurence of plural seedlings and because it is generally impossible to determine the origin of plural seedings, the frequency includes all types of polyembryony. When the number of embryos is large there is greater competition amongst them and only a few germinate. There is thus a direct corelation between the number of embyos developing and their mortality. Highly polyembryonate seeds *e.g.*, Eugenia, produce only 1—2 seedlings.

A keen competition is often noticed between the sexually produced embryo and the nucellar embryo. The nucellar seedlings are more commonly noticeable than the gametic seedling. The gametic embryo is usually crowded out by the nucellar embryos. Often the gametic embryo is entirely suppressed in which case the progeny resemble their seed parent.

The gametic embryo has usually a lesser chance of survival because the fertilized egg begins to divide when most of the nucelar embryos consist of several cells each; the young gametic embryo is situated at the apex of the embryo sac and thus is less favourably placed than the nucellar embryos with respect to nutrition and space within the sac.

In many cases the pollen parent influences the relative proportions of genetic and nucellar progeny.

Environmental conditions also influence the development and survival of seedlings. Thus several varieties of the mango which are monoembryonate in a locality may be polyembryonate in others. The difference may, however, be due to both, environment, and cross pollination.

The position of the embryo is also an important factor in its survival.

Other factors influencing polyembryony are the nature of the food supply; the moisture supply to the developing embryos; temperature; the age of the seed; the maturity of the seed; the dessication of the seed, etc.

Pollination and Polyembryony.

'Fertility' is spoken of as the capacity for reproduction by gametes with fertilization.

'Sterility' is the absence of capacity for sexual reproduction. Complete sterility results in complete inability to reproduce by means of seeds. In plants having nucellar embryony besides sexual sterility, nucellar sterility is also required.

The absence of pollination usually but not always prevents the development of nucellar embryos. As has already been said, fertilization of the egg is also required in a number of cases. Thus gametic sterility usually necessitates nucellar sterility, but the abortion of the gametic embryo does not.

Horticultural significance of polyembryony.

One of the great advantages of polyembryony is in the standardization of rootstocks. The rootstock and the scion should be physiologically congenial. Through polyembryony a large number of genetically uniform stocks can be obtained. Nuceller embryony brings about a sort of natural vegetative propagation. The rootstocks should have the same parentage and should react in the same way under the same environmental conditions with a given scion variety. To obtain such uniform stocks, experiments have been tried towards vegetative propagation by cuttings or layers of known types of stocks. A good example of this is the East Malling Research Station in England where such vegetative propagation of the rootstocks is made use of in the propagation of the apple. In some citrus seedlings apogamy to the extent of 100% is reported, and the gametic seedlings can easily be eliminated from a batch of nursery seedlings.

Thus polyembryony results in the production of uniform seedlings. Vegetative propagation is somewhat tedious. Polyembryonate varieties can be easily propagated by seeds and the various benefits of vegetative propagation could be safely and easily made use of by this phenomenon. The Saber mango grown in S. Africa is commonly grown from seeds and it is believed that it comes true to the variety. The polyembryonate Phillipine mangos could be advantageously introduced into India for seeing as standard stocks for grafting the monoembryonate Indian varieties. Some varieties in South India are polyembryonic and can be similarly used.

Seedlings as a result of polyembryony being less tedious are also cheap and economical. The seeds in such varieties produce viable embryos which have no direct relation to the regular egg apparatus and fertilization.

Nucellar embryony also produces seedlings which are greater in vigour as compared to their gametic contemporaries. Hodgson and Cameron and several other investigators report that asexual seed production in the citrus results in a marked and persistent rejuvenation and vegetative invigoration. The invigoration manifests itself in the cross sectional area of the trunk and the volume of the top. The growth habit of such trees is more upright.

The seed content of the fruits in some cases is also lower.

The nuceller progeny is often early and heavy bearing.

Nucellar clones are also hardier than the 37 gotic ones.

This phenomenon of rejuvenation is also known as 'neophyosis'. The vegetative invigoration, however, declines with the increasing age of the tree. The increased vigour in the case of nucellar seedlings is transmitted in successive propagations by budding over a number of years.

The age changes, or clonal senescence can be got rid of by a sexual seed reproduction.

One of the great disadvantages in the propagation of polyembryonate seeds is that one has to grow a large number of seedlings just to secure a few hybrids. Nucellar embryony hinders the origin of new types. Therefore, in hybridisation work with the mango, citrus and other fruits the use of monoembryonate varieties is suggested.

Nucellar citrus seedlings are undoubtedly more vigorous, but at the same time they are considerably thorny which is another disadvantage.

THE ROLE OF PHOSPHATE IN MIXED FARMING*

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Mixed farming is advocated as a system under which crop and animal production operate in support of each other. The animal supplies manure to fertilize the soil and thus increase fodder and food-crop production, out of which the animal also can be better fed. Since better standards of feeding are required to enable improvement by better breeding method to express itself, the higher standard of animal nutrition which results, makes improvement in animal breeding and animal efficiency possible. Thus working together, they provide not only higher yields of food crops but also a wide range of dairy and animal products to form the basis of diets which ensure a higher standard of human nutrition and health.

The Indian cultivator as a mixed farmer.

Since the mixed farming cropping system always includes some fodder legumes and pulse crops, soil fertility is further protected from depletion, because these crops add to the soil nitrogen taken from the air. After their removal, they leave in the soil some fertilizing crop residues made up of organic matter, well supplied with nitrogen, from which supplies of plant food become steadily available to the following crops. As indicated below, however, the effectiveness of this source of fertility in India is less than is generally assumed. In this there is nothing new or anything which has not already been well-demonstrated in many parts of the world. In India nearly every cultivator, to some extent, practises a system of mixed farming. He maintains cows and buffaloes and tries to breed his own work cattle and produce a supply of milk and dairy produce, the extent depending on the size of his holding and other facilities available. Circumstances may limit him, however, to goats, sheep or poultry.

When the system has so many advantages to offer, it may well be asked, why there is so little evidence of progress in the adoption of a system which offers higher standards of efficiency in both crop, and more particularly, animal production, and a wider recognition of the possiblities the system offers of providing India with food standards commensurate with both immediate and future needs.

*Reprinted from Indian Farming, Vol. VII, No. 11, November 1946.

Grain and animal product markets compared.

After the cultivator has met certain requirements in regard to food and clothing for himself and his family, it is the money profit motive which decides the form his farming system will take. Money he must have—the general idea is, the more the better, the soundness of which in the past has never been much disputed. Money, or the lack of it, has shaped his system of agriculture. The amount of money he gets is decided largely by markets. Good markets and good marketing organization for grain, mean money profit and ensure the position of grain production in the agricultural system. Poor markets and bad maketing organization and transport facilities for milk and dairy products mean low money profit from these products and the least possible interest being taken in them by the man who should constitute the main producer, that is the mixed-farming cultivator. They also entail high prices and poor quality, that is poor value for money, to the consumer and likewise a lack of interest on his part.

It may be argued, however, that even in areas near large towns and big milk and dairy product-consuming centres, where markets are better than in the more distant villages there is little evidence of any progressive development on these lines. It would seem that even the best milk markets in the country are not good enough to provide that volume of turnover and security of profit necessary to change the course of agriculture and to develop a steady and progressive trend in the direction of mixed farming, however desirable it may be on general grounds.

Lack of transport facilities and control over adulteration and other throat-cutting practices kill markets. Production, therefore, is driven into alternative channels. So the mixed-farming cultivator tends to limit his animal production to his own bare requirements and concentrates his energy on production for the grain market. In animal production he concentrates mainly on the production of work cattle to provide the power for growing grain, the steady market for which reflects the relatively steady market of the grain they help to produce.

Need for fertility-building crop rotations.

But animal efficiency being low, the number of animals maintained in any given area is high compared with many

countries. Manure, therefore, should be fairly plentiful and crop yields stand better in comparison with those of other countries. Some of the blame for the low yields must undoubtedly be put on the practice of using cowdung as fuel, but this alone cannot account for the great difference in yields. The ratio of cultivated area to grazing in India is much higher than in most countries with which comparisons in crop yields are made. Generally the grazing areas do not provide the extra manure needed to maintain the fertility of the large cultivated area. Considerable improvement in the yield of fodder from grazing areas will be needed to make their contribution in this direction of much value. The present output of farmyard manure is sufficient to manure every year about one acre in ten under single cropping. Under double cropping the figure would be one in twenty. To maintain soil fertility two and half times as much farmyard manure as is now produced is required under single cropping but five times as much would be required to secure good yields under double cropping.

The cultivated area, therefore, must very largely support its own fertility and the system of farming must be such as ensures this, otherwise depletion of soil fertility will take place as it undoubtedly is taking place. Yields will decrease with every attempt to increase the intensity of crop production to meet the increased demand for a better standard of food consumption of a rising population.

As already stated mixed farming rotations always include a number of legume crops—fodder and grain. Cultivators in this country are well aware of the value of legumes in rotations, and make considerable use of them for maintaining fertility. India has a wide range of legume crops. There are hardly any in the world which cannot be grown. Still, over wide areas, soil fertility is depleted and yields are low and there is evidence that they will decrease as further attempts to intensify cropping are made.

Judged from the point of view of fertility, rotations are, in the main, planned on sound lines. The standard of cultivation, moreover, is not as low as is often urged. Under Indian soil condition the wooden plough is not the inefficient implement it is often represented to be. Still yields are low. They are clealy links missing in the chain which holds fertility and crop production together. This article deals with one of them.

Fertility efficiency of legumes dependent on phosphate.

Though a large range of legumes is freely used in rotations they fail to maintain fertility at the level which might be expected judged by the results obtained in other countries. Even when a good standard of cultivation is practised the legumes are not, under present conditions, doing their job as efficiently as elsewhere. They are not living in the soil that amount of fertility needed to ensure high yields of subsequent crops, though the sum total of nitrogen which they contribute must amount to a very large figure. The legumes now mainly favoured are the pulse grain crops. Though of considerable fertility-building value they fall below the fodders, the clovers (*Trifolium*) such as berseem, or red and white clovers of more temperate countries, lucerne (*Medicago sativa*), *senji* (*Melilotus*). It has been shown in recent experiments at the Imperial Agricultural Research Institutè, New Delhi, that the clovers operate efficiently only if well-supplied with available phosphate. Here then is a probable explanation—the pulse crops have not the high fertilizing value of clovers used in mixed-farming rotations abroad and the clovers, except when grown in the phosphate soil of west Punjab, do not yield well unless supplied with phosphate either in the form of farmyard manure or as an artificial fertilizer. When so supplied, not only do the yields increase considerably but the soil fertility-building processes of the legume are much activated, with the result that big increases in yields of the following cereal crops are also secured.

Importance of phosphate circulation.

The matter does not end here. The fodder so produced is also very rich in phosphate and calcium. In experiments it has been found that the phosphate content of the fodder has been increased three and four times. When these fodders are fed to cattle very little of the extra phosphate is retained by the animal. Most of it reappears in the dung, which, if returned to the soil and applied to a legume crop will again set afoot a cycle of activity which will result in large supplies of nitrogen being fixed in the soil. Further the phosphate will be taken up again by the legume and continue in circulation accumulating fertility as residual organic matter increases and nitrogen is taken from the air.

Inherent soil-fertilizing power of mixed-farming cropping systems.

It is this process which constitutes the real power which lies behind mixed-farming practices and which has firmly

established the system and wedded the animal to the soil in other countries. The most efficient nitrogen and fertility builders are the leafy legume folders as the clovers (*Trifolium*), the *Medicago* lucerne and *Melilotus senji* groups. They appear to be most efficient users of phosphate. To convert them into marketable dairy produce efficient milch cattle are required, and to turn this into profit comparable to grain production, secure markets for milk and dairy produce and reliable transport systems must be organized. Given adequate supplies of phosphate, efficient cattle and dairy produce markets, not only can the milk and dairy produce required by India be guaranteed but a high standard of soil fertility can be built up, from which increased yield of food crop can be assured and the whole trend of soil-fertility depletion be reversed and replaced by soil-fertility accumulation.

Lack of phosphate in the soil not only effects the yields obtainable from legumes but also the actual distribution of the valuable species. This limitation is tending to confine berseem to certain areas of the Punjab and Sind. The distribution of good types of cattle and other animals is affected in a similar way first directly by a lack of phosphate in all feeds and indirectly by the absence of good legume species.

Possibilities of double cropping.

There is another aspect of this question which deserves attention. In India usually two crops can be grown in the year. In some areas three are grown. Provided water is available and soil fertility maintained at a high enough level two or even three crops can be grown on the same field in the same agricultural year. The actual cropped area of India can be double the actual croppable area of the country. Since plant growth is continuous throughout the year, area for area the actual crop-producing capacity can be double that of countries with temperate climate where the crop-growing seasons last only for six or seven months and nature sleeps for the rest of the year. Indian agricultural statistics show that double cropping has, for some time, been increasing rapidly in certain heavily populated areas.

The experiments referred to above indicate that the nitrogen and organic matter supplies can be assured if adequate phosphate is applied to the legume crops. In America it has been estimated that one pound of phosphate will produce three pounds of nitrogen. Since the market

price of phospate is usually less than half that of nitrogen the conversion rate in terms of money is actually one to six at pre-war prices, three annas to eighteen annas per pound of phosphate applied. The experiments carried out at New Delhi suggest that a similar return may be expected in India soils. Phosphate is the hub of the wheel on which crop production revolves. Above it has been shown that the phosphate can be put into circulation through the crop and animal and brought back to the soil again in the manure. The more frequently the cycle is completed and the manure is applied to a legume crop the greater the amount of nitrogen which will be fixed in the soil. Looked at from the phosphate angle the practice of putting farmyard manure and refuse containiug phosphate into pits to rot for six months merely immobilizes the phosphate for this period when it could have been fixing nitrogen from the air, had it been applied even in raw state direct to a legume crop, particularly legume fodder crop.

In European countries, where only one crop can be grown in the year, farmyard manure has to be stored as there is only one crop on which it can be used, and unless it is carted to the fields when the ground is either dry or frozen considerable damage to the land ensues. Storage therefore cannot be avoided. But in India where double cropping can be practised, and in each season a legume will be grown it would appear that immediate application to the legume will increase considerably the efficiency of the manure. The whole idea of manuring legumes is contrary to ordinary conceptions as to how manures in this country should be used. The short view of applying the manure to the crop which will pay for it immediately has prevailed. Long-term consideration of soil fertility have been relegated to the background in favour of the short-term demand for immediate profit. In other words the one means of building up and maintaining fertility in Indian soil has always been neglected and this supplies a reason why little progress has been made in mixed farming and why crop yields generally are depressingly low.

Real role of phosphates overlooked.

Till recently the view was that for present yields, Indian soils were in the main adequately supplied with phosphates and that no adequate return was to be expected from phosphate manuring.

For reasons which are difficult to understand the possibilities of using phosphate with legumes to stimulate growth

and thus nitrogen fixation and soil fertility building, have been completely overlooked. This is surprising when nitrogen starvation was so evident and the need for securing nitrogen from every possible source fully realized. The possibilities of this indirect method seem never to have been examined.

Policies of despair.

The high average milk yield and overall efficiency of the Sahiwal and Tharparkar herds of the Imperial Agricultural Research Institute show that the breeding of efficient milk and dual-purpose cattle in this country is no empty dream or something beyond the capacity of the average intelligent mixed farmer provided prices can be arranged to make it economically attractive. If the defects of transport and marketing are removed there is no need to despair of the milk position from the production point of view. The advocates of policies based on the production of milk and dairy substitutes as vegetable oils have not realized the implications of their policies in regard to crop production and the effect they will have on crop yields. The proposal, however, is of academic interest only as it is quite unlikely that vegetable oils will find acceptance with the Indian public as a substitute for milk. The advocates of soyabean milk as a substitute for the real thing are on a slightly better wicket. Soyabean is a legume and should be capable of adding nitrogen and fertility to the soil. In experiments at Delhi and Karnal, however, it has so far made poor showing in comparison with indigenous *kharif* pulses from both grain and fodder points of view. It may be, moreover, that the same amount of soyabean will produce more milk when fed along with suitable roughage and crop by-products to efficient milch cattle than it can produce, as soyabean milk. But it is the leafy herbaceous legumes such as the clovers which fix nitrogen in real abundance and which can use phosphate to build up fertility for high cereal crop yield. It is through the conversion of these into milk and animal products that phosphate circulation is set up and fertility-building processes set afoot. In this conversion cattle play an indispensable part.

It is the failure to make effective use of legumes as fodders and green manures through the use of phosphate fertilizers, that is the missing link in the chain of operations needed to make mixed farming in this country the effective force in crop and animal production it has proved to be in Western countries.

Change of outlook on manuring problems.

There is need for a considerable change of outlook on manuring problems. The short-term methods which have led only to soil depletion must give place to fertility-building practices. Research needs new guidance. The development of mixed-farming has suffered from lack of direction, not to say, some misdirection in this matter.

In the tube-well and canal-irrigated areas particularly, and also in areas supplied by open wells at least where the water level is fairly high, leafy legume fodders such as berseem, lucerne, *senji* (*Melilotus*), *methra* (*Trigonella*), etc., can be easily grown. Given markets for milk and dairy produce some of these areas provide ideal conditions for mixed-farming development. Given adequate supplies of phosphate the legumes will fertilize the soil by the accumulation of nitrogen and the phosphate will be kept in circulation by the animals consuming the phosphate-rich protein fodder thus produced. The development of crop production combined with thriving animal production industries is dependent on an understanding of the development of soil fertility through the growing crop. Some indication of the possibilities of legumes in conjunction with phosphate is given above.

Because of its poverty, the soil of India calls for a better understanding of its requirements. One of these is organic matter. Sufficient farmyard manure can never be produced to meet the requirements of the large cultivated area under a system of single cropping, far less under double cropping, to which India is suited by virtue of her climate and should learn to adopt. The production of organic matter must become an integral part of the crop rotation. Nitrogen, moreover, is required in enormous quantities, a large proportion of which must also be obtained through the cropping system itself. The legumes are the crops which can supply this nitrogen along with organic matter, particularly if used for green manuring, and keep crop production on a high level of yield.

Improvement of the various legume species, particularly of the fodder legumes, by breeding and selection, and the fitting of improved varieties to various soil conditions and crop rotations is likely to prove of much more immediate advantage to agriculture than the production of higher-yielding varieties of cereal crops. Just as it serves no purpose to breed improved cattle without, at the same time, ensuring

a better standard of feed, the full expression of the inherent yielding capacity of improved cereals is not obtainable without a higher standard of soil fertility than now generally exists. Their use without manures offers not only little long-term advantage but may lead to further soil depletion and ultimately lower yield.

The manurial requirements of legumes need thorough working out. The experiments carried out at the Institute have clearly shown that when adequately supplied with phosphate (superphosphate) the question of the supply of nitrogen from the soil to which so much attention has been given in the past can very largely be left to look after itself.

BOOK REVIEWS

SUGARCANE CULTIVATION by K. M. Gururaja Rao, pp. 127, with 13 appendices, 24 illustrations, and a foreword by Rao Bahadur Sir T. S. Venkatraman, Published by the Bangalore Printing and Publishing Co., Ltd., Mysore Road, Bangalore City.

Sir Venkatraman, mentions in his foreword that the book contains the practical experience of Sugarcane growing, on plantation scale by an experienced worker.

The book is divided into two parts, *e.g.*, Part I, in which is given the principle of cultivation, under the following sub-heads, chapterwise—History of Sugarcane, Morphology of the plant, Periodicity of growth, and the theory of formation of sugar. Varieties of cane, soils, manures and irrigation. Yields of Sugarcane and field estimates. Insect pests and diseases.

Part II deals with practical suggestions for Sugarcane plantation under the following sub-heads, *viz.*, Climate soils; Growing of green manure crop preparatory to cane; Preliminary operations; Planting of cane; After cultivation; Maturity in cane; Ratoon, cost of production of cane.

The subject matter has been dealt at length, as regards certain aspects. The first part deals with the crop under Indian conditions, while the second part emphasizes more on Mysore conditions.

The appendices, and illustrations are helpful as regards information.

It is a helpful reference book for students of Agriculture, and farmers in general.

—N. R. DEY,
Allahabad Agricultural Institute.

ELEMENTS OF TROPICAL SOIL SCIENCE by T. Eden, D. Sc. Macmillan and Co., Ltd., St. Martins Street, London, p. 136, 1947.

In recent years there has been an increasing demand for text books on soils under Indian and allied conditions; this, therefore, is a welcome addition. The book is elementary in nature, suitable for the general reader and the farmer; it is inadequate [illegible] a text-book for students of agriculture and soil science.

Chapter I deals with the origin, and formation of soils. Chapter II deals with the physical properties of soil, mechanical analysis of soil bring given in detail.

In Chapter II the chemical properties of soil are presented, while in Chapter IV the organic chemical aspect is dealt with, illustrating carbon and nitrogen in a novel manner.

Methods of composing and green manuring are dealt with in Chapter V.

Chapter VI briefly mentions the effects of cultivation and of mulches.

Soil erosion and drainage are presented in Chapter VII.

Chapter VIII suitably presents the commonly-used fertilizers, giving their uses.

Field experiments have been adequately dealt with in Chapter IX, but seem out of place in such a text-book.

It would have been helpful, as regards the practical aspects, for the farmer in general, if the author had dealt in detail with organic manures, cultivation and drainage.

Published by :—The Allahabad Agricultural Institute, Allahabad, U.P. (India.)

THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL

OF

AGRICULTURE AND RURAL LIFE

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Vol. XXII **MARCH, 1948** **No. 2**

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The Allahabad Farmer is now approved by the Directors of Public Instruction in the United Provinces, Bengal, Central Provinces, Sind, Assam, Bihar and Orissa, the Rural Reconstruction Commissioner, Punjab, and by the Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to Rajputana and Central India States, for use in all schools under their jurisdiction.

Subscription Rates

Annual subscription: India, Rs. 3; England, 4 shillings; U. S. A, 1 dollar. Single copies 10 annas; over five years old, 12 annas. Copies which are not received by subscribers will be supplied free of cost within six months of the month of issue. Thereafter single copy price will be charged.

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Contributions

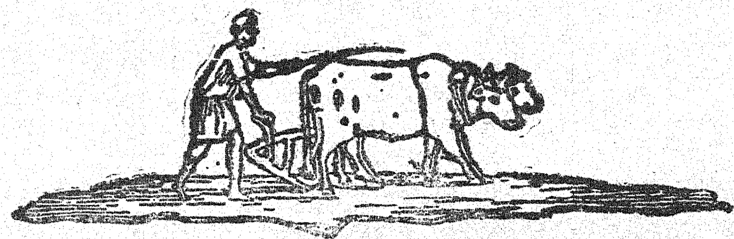
The Allahabad Farmer is published in the first week of each alternate month commencing with the month of January. Contributors are requested to send in their articles at least one month prior to the next prospective date of publication.

Contributors will receive 15 reprints of the article published and additional copies at cost.

Publisher—The Allahabad Agricultural Institute, Allahabad, U. P.(American Presbyterian Mission).

Printer—The Mission Press, Allahabad, U. P.

THE ALLAHABAD FARMER



VOL. XXII] MARCH, 1948 [No. 2

MY DREAMS FOR THE AGRICULTURAL INSTITUTE

BY

A. T. MOSHER, PH.D., PRINCIPAL,

Allahabad Agricultural Institute.

The Principalship of the Agricultural Institute is different from that in many other schools and colleges. Our Principal cannot dictate our policy. We make our choices democratically. The Principal can only participate as a member of the group, in making these decisions. But nothing can stop him from dreaming. And I would like for you to know what my dreams are for the Agricultural Institute.

I think every one of us who has been here five years or more is here because he wants to be, because he believes in our Institute. Some of you have not yet been here that long. Rightly, you want some practical experience and you believe this is a good place to get it. Some of you who feel that way now may change, in a few years, and may want to stay here permanently. You, too, may come to believe in the Agricultural Institute not just as training but as a career.

I believe in the Agricultural Institute.—I believe in its goals and I believe in its method. Its goals are to try to help meet the staggering needs of India (*a*) for food, health, and wholesome village life, and (*b*) for fine, mature men and women. Thirty-seven years ago, Sam Higginbottom founded this institute because he felt he and other Christians must do something about the appalling hunger of India. Our programme has grown with the years. We have taken up more

and more ways of trying to alleviate that hunger: agriculture, dairying, agronomy, horticulture, animal husbandry, agricultural engineering, and home economics. The hunger of India—her need for food—is still staggering, and trying to help meet that need is still part of the goal of the Agricultural Institute.

But at least as great as India's need for food, is her need for fine men and women. She and the world need men and women with sound *knowledge*. How great is the number of posts in this land today, now that India has independence, for which there are not men and women with sufficient sound knowledge. We need more well-trained agriculturists, administrators, research workers, teachers. In addition to this, this land needs men and women of *integrity*. She needs people who are honest, who have the courage to be honest—financially, intellectually, and morally. She needs men and women whose acts measure up to their ideals. Beyond this, India and the world need men and women who have *understanding*. This is much more than knowledge. This is a matter of understanding human nature, of understanding the nature of God and the nature of the world, of understanding society (the nature and contributions of politics and the contributions of the home), and of understanding one's self. And even beyond this, India and the world need men and women of *confident action*. We need men and women with such confidence in God and with such acceptance of themselves that they will stand for something, and work for something and persevere steadfastly no matter what the obstacles. *India needs whole men and whole women.*

On a tombstone in a cemetry in America, there is this inscription: "Here lies so-and-so, born a human being, died a retail grocer.' If it were in India, it would probably read:

> "Here lies Prem Das
> Born, a human being
> Died, a *pan-wala*."

It might equally well read:

> "Here lies So-and-So
> Born, a human being
> Died, a teacher."

One of the great tragedies of our age is that our education so often trains boys and girls to become farmers, economists, teachers, engineers; it so seldom trains them to become whole men and whole women. Remember the atomic scientists who, having given all of their specialized training to

create a bomb, finally awoke to realize that it was not safe for them to trust the fruit of their specialization to the decision of others who had strong beliefs? They realized at last that they were themselves morally responsible and that they must participate in the moral decisions of their nations. They came to realize that it is not enough to be a competent technician; in the life of today each of us needs to be a whole person.

I believe in the Agricultural Institute because I believe that we can increasingly make one of its major goals the education of a few of the whole men and the whole women which the world so desperately needs.

And I believe in the *method* of the Agricultural Institute as well as in its goals. That method is the method of the *community*, of the staff-student *fellowship*. We are not outstanding as individuals; we are ordinary stuff. But we can, if we will, become an "uncommon fellowship of commonplace persons," and that uncommonly fine fellowship can be the method by which we can achieve our goals.

Believing in our goals and in our method, what is my ultimate dream for the Institute? Where do I hope we will some day arrive?

I hope that some day the Institute will have an outstandingly strong staff, a staff of which each member will be well-trained and highly competent in at least one particular phase of rural life or of Agricultural or home science.

I hope that it will have a staff whose members love each other. Not that we shall not have differences of interest, differences of opinion, differences of judgement, and even differences in our dreams. These differences are necessary to our success. They are part of that which can make a fellowship more productive than individual effort. But I hope we can have a staff whose members love each other in that they respect each other, in that they have confidence in each other, in that they refrain from questioning each others' motives. If our fellowship is to serve our goals, it must be made up of people who love each other.

I hope we will have a staff each of the members of which is driven from within. It is easy to complain that we are over-worked. Yet I am less concerned about how much we work than about why we work. My dream for the Institute is one in which each of us shall be producing to his limit, not

because he is driven from without by too many assignments, by too many class hours, by to many responsibilities, but driven from within because he is gambling his life on the validity of our goals and of our method, because he is too thankful for his fleeting opportunities to let any energy go unused. Just now some of us are too much driven from without, by too many imposed burdens. I hope we can decreare this pressure of imposed burdents, not in order that you may have time to kill but in order that you may have a chance to be driven from within, to drive yourselves.

I hope we will have a staff of men and women who believe that helping young men and women grow into whole persons, competent to tackle some of the knotty problems of rural India, is a great vocation. I hope that staff will have the necessary tools to follow their great vocation : the tools of equipment, of adequate security, and of intellectual freedom. I hope it will be a staff of people forever dissatisfied with themselves and always studying and praying and pondering to deepen their own understanding, and to broaden their own sympathy. I hope it will be a staff whose members realize that if they are to serve rural India they must know rural India, that each of us will be intimately acquainted with one village or with one section, and casually acquainted, by travel and by study, with several different regions of this great land.

That is my dream for the future. Within this, I have a few specific dreams for the coming school year of 1948-49.

First, I hope that in this year we shall "pull up our socks," or "put our house in order." It will a long time before we can build all of our buildings, grow all of our trees, gather all of our staff. It would be easy to delay all of the finishing touches until those basic items of growth are provided. To do that would be to live for many years in a half-finished state, and that would mean that additional generations of students would come and go with scaffolding all around them.

They say that a small American college, badly in debt and nearly bankrupt, installed a new president. The Board of Directors was appalled that his first proposal was to spend $ 800 for a lawn-mower. His reply to their objections was, "Gentlemen, if this college has to die, let us at least die with our hair cut."

We are in no danger of having to close the Agricultural Institute, but this attitude makes sense to me. It will be as easy now as later to begin keeping our windows washed, our grass

trimmed, our gateways attractive, our classes prepared for and met regularly and on time, our grades in on time, our financial accounts scrupulously up-to-date. Let's pull up our socks this year. Let's keep the grounds around our homes neat. Let's begin to have the appearance of a compound devoted to our high goals.

Second, I hope this year that we can build up some reserves in our financial position. When there is so much more that we need it is easy to let the Institute continue to live "from hand to mouth." But we can grow just as rapidly once we have laid up a few reserves as we can without them. Maintaining adequate reserves is a matter of habit, and it is a habit which can add serenity and security to the way we do our work. Let's accumulate those reserves in 1948-49.

Third, I hope that we can increase our resources for further expansion. We have some of those resources now, and are being held to a slow pace by lack of building materials. But well ahead of the time when we have used all of the resources we have I hope we can gather further resources, and I hope that we will have more money on hand for buildings and equipment a year from now than we have today.

Fourth, I hope that within this year we can continue to grow together as a staff, and as a staff-student community. I hope we can have more staff social affairs, more staff sports and more staff-student affairs. I hope we can have more and better staff seminars, more working together between departments on selected home and agricultural problems.

Fifth, I hope we can deepen our own understanding and that of our students. We have two splendid opportunities to do this in this coming year. One is our new programme of courses in Religious Education and in Citizenship Training. I hope every staff-member will help teach at least one of these, and that many of us will take part in both of them. We need these quite as much as the students do. Each of us is a product of the same mistaken kind of education which tends to make us specialists rather than people. We need to know more about God, about the world, about politics, about society, about India's heritage. These new courses are our opportunity to grow ourselves, in the process of helping our students.

Our second opportunity to deepen our own understanding this year is to plan and to carry through an enlarged programme of outside lectures, of concerts, of selected cinemas, of special staff-student events.

Finally, I hope that during this year each member of our staff will take a fresh grip on himself. It is all very well to have great dreams for the Agricultural Institute, but in the last analysis whether we can reach those goals will depend on the kind of people we are as individuals You may feel as I do, that such an Institute as my dreams envisage would be wonderful, when I look at myself critically I must confess that I, but with my weaknesses and self-centredness, could hardly be a member of such a fellowship. It would require men and women much more capable and much more humble than we are, to make these dreams come true.

They tell of a minister in a parish in America whose work was going badly. One day he sat down and listed all of the defects of his parish. He sent down all of the failures, all of the disappointments, all of the feuds, all of the jealousies. After thinking about this list for a while, his honest conclusion was this: that "This parish must have a new minister." He pondered this conclusion for a while, in despair. Then he straightened up, took a deep breath, and added a resolution to it: "This parish must have a new minister, *and I will be that man!*"

That minister dared to add his resolution because he had confidence that God can transform people and can make them what they could never be by themselves. Sam Higginbottom believes that. John Goheen believed it. You and I, deep down in our hearts, believe it, too. The Agricultural Institute needs new people on its staff if it is to reach its goals. You and I, by the grace of God, can be those new people.

Let's take a fresh grip on ourselves this year. By study, by prayer, by worship, by self-discipline, let's become the new people who can make your dreams and mine for the Agricultural Institute come true!

HOW TO INCREASE THE VILLAGE FAMILY'S MILK SUPPLY

By

M. VAUGH, A. E.

In the November, 1946 issue of "INDIAN FARMING," Sir Frank Ware, then Livestock Adviser to the Government of India, admitted that there was no reason to hope to be able to produce the amount of milk in India that would be required to bring the level of consumption up to that recognised as the minimum desirable for nutritional needs. It was also pointed out that the deficiency was relatively worse in rural than in urban areas. The following suggestion, with reasons, may be considered as a possible means of improving the situation.

Sir Frank pointed out that, while improvement in the fodder supply was undoubtedly possible, there was no possibility of setting aside the amount of land for either grazing or for production of cultivated fodder that would be required to keep the necessary animals. I agree that the present number of animals presses heavily on the fodder supply, too heavily in fact for animals to be efficiently fed. There is urgent need to increase the fodder supply for the present number of animals, or for a decrease in the number of animals kept, or both. While it may not be possible to increase the number of animals, it may be possible to substitute one kind of animal for another, *particularly to substitute female animals* for the males now used for work animals.

Unfortunately this suggestion has both economic and religious implications in India. Traditionally cows are not worked in most parts of India, though the census figures show that some 3,500,000 females are so used in India. I am told that search of the Hindu scriptures by Hindu *pandits* have shown that there is no scriptural prohibition of the working of females, that the practice of not working them is based entirely on custom. There is reason to believe that the veneration of the cow arose from economic reasons; if that is true, it seems reasonable to belive that the way such veneration has developed can be modified for sufficient reason in the interest of economic welfare of the country. It is admitted however, that for extensive gain to result, it would be necessary to dispose of the males somehow as well as to work the cows. This article will be concerned with the economic and health aspects and will not deal further with the religious aspects.

At present, most village cultivators have little or no milk supply. The farmer must keep a pair of work animals. He does not have feed enough to support more than the two

Finally, I hope that during this year each member of our staff will take a fresh grip on himself. It is all very well to have great dreams for the Agricultural Institute, but in the last analysis whether we can reach those goals will depend on the kind of people we are as individuals You may feel as I do, that such an Institute as my dreams envisage would be wonderful, when I look at myself critically I must confess that I, but with my weaknesses and self-centredness, could hardly be a member of such a fellowship. It would require men and women much more capable and much more humble than we are, to make these dreams come true.

They tell of a minister in a parish in America whose work was going badly. One day he sat down and listed all of the defects of his parish. He sent down all of the failures, all of the disappointments, all of the feuds, all of the jealousies. After thinking about this list for a while, his honest conclusion was this: that "This parish must have a new minister." He pondered this conclusion for a while, in despair. Then he straightened up, took a deep breath, and added a resolution to it: "This parish must have a new minister, *and I will be that man!*"

That minister dared to add his resolution because he had confidence that God can transform people and can make them what they could never be by themselves. Sam Higginbottom believes that. John Goheen believed it. You and I, deep down in our hearts, believe it, too. The Agricultural Institute needs new people on its staff if it is to reach its goals. You and I, by the grace of God, can be those new people.

Let's take a fresh grip on ourselves this year. By study, by prayer, by worship, by self-discipline, let's become the new people who can make your dreams and mine for the Agricultural Institute come true!

HOW TO INCREASE THE VILLAGE FAMILY'S MILK SUPPLY

By

M. Vaugh, A. E.

In the November, 1946 issue of "INDIAN FARMING," Sir Frank Ware, then Livestock Adviser to the Government of India, admitted that there was no reason to hope to be able to produce the amount of milk in India that would be required to bring the level of consumption up to that recognised as the minimum desirable for nutritional needs. It was also pointed out that the deficiency was relatively worse in rural than in urban areas. The following suggestion, with reasons, may be considered as a possible means of improving the situation.

Sir Frank pointed out that, while improvement in the fodder supply was undoubtedly possible, there was no possibility of setting aside the amount of land for either grazing or for production of cultivated fodder that would be required to keep the necessary animals. I agree that the present number of animals presses heavily on the fodder supply, too heavily in fact for animals to be efficiently fed. There is urgent need to increase the fodder supply for the present number of animals, or for a decrease in the number of animals kept, or both. While it may not be possible to increase the number of animals, it may be possible to substitute one kind of animal for another, *particularly to substitute female animals* for the males now used for work animals.

Unfortunately this suggestion has both economic and religious implications in India. Traditionally cows are not worked in most parts of India, though the census figures show that some 3,500,000 females are so used in India. I am told that search of the Hindu scriptures by Hindu *pandits* have shown that there is no scriptural prohibition of the working of females, that the practice of not working them is based entirely on custom. There is reason to believe that the veneration of the cow arose from economic reasons; if that is true, it seems reasonable to belive that the way such veneration has developed can be modified for sufficient reason in the interest of economic welfare of the country. It is admitted however, that for extensive gain to result, it would be necessary to dispose of the males somehow as well as to work the cows. This article will be concerned with the economic and health aspects and will not deal further with the religious aspects.

At present, most village cultivators have little or no milk supply. The farmer must keep a pair of work animals. He does not have feed enough to support more than the two

animals so he has no females to produce milk and he buys bullocks when it is necessary to replace his work animals. When cows are kept, in addition to bullocks, usually because of the very poor food supply as well as for genetic reasons, the cows give little or no more milk than is consumed by the calf. Thus the cow only provides replacement bullocks, nothing more.

When the suggestion of working cows is made, two questions always arise: (1) are they able to work? (2) does working them reduce the milk yield? Both questions have been investigated. Experience is that female work animals are not inferior to males for farm work. In Europe, where cattle are still worked, practically always it is cows, not bullocks, which are kept. In countries where horses are used, farmers usually keep mares, selling the male animals to non-farm use. At the Agricultural Institute, Allahabad, we have an experimental farm of 40 acres which has been worked for several years almost entirely by cows. They have proved to be in no way inferior to bullocks for work purposes, in fact in some cases where a male and a female have been worked together the female has usually proven the better worker. There seems to be no reason at all to question the ability of a pair of cows to do without difficulty the work required on the ordinary holding.

The question of effect on milk yield is admittedly not so easily answered, mainly because there is less evidence available. Only one specific foreign study is known on the point. Careful tests of fairly heavy yielding Swiss cows worked for 4 hours a day did not show significant decrease in yield. It is known that large breeds of work horses in the West not specifically bred for milk yield often have much more milk than the colt can use and that milk yield is not adversely affected by heavy work. It is reported that buffalo cows in milk are commonly worked without detriment to yield in certain districts of the Punjab. The 35 lakhs of cows reported to be used for draft purposes in India are reported as used for "draft only" so no information is available on the subject from the census reports.

Results of our work at Allahabad are not considered conclusive as yet. Several of the cows used so far had not bred before they were put to work. Some did come into heat after being worked, were served and produced normal calves. All the cows used so far were defective in some way and were poor yielders in every case, to begin with. Maintaining the milk yield was not a primary part of the experiment. They

have been fed the roughage available on the farm, mostly weeds, grasses, some fodder from which the grain had been removed, some *bhusa*, the sort of feed that a farmer would be able to provide. The grain or concentrate given them has been less than half the quantity given to the Institute work bullocks of similar size. The amount of milk was not sufficient to justify having someone from outside either do the milking or supervise it to ensure accurate reporting of the quantity. The men working on the farm have been allowed to take the milk for their own use. Probably in the beginning at least, prejudice against working the cows tended to lead to minimising the amount of milk produced as an argument against working the cows. Later, possibly fear of losing the milk if the full amount were reported may have entered into it. The impression they give is that working the animals leads to some reduction in yield. On the other hand, they have received bare maintenance rations for work animals or less. No attempt has been made to increase or maintain the yield by increasing the feed. Undoubtedly the milk they have gotten has been a factor in inducing the men to work the cows in the face of active opposition and even of threats from surrounding villagers. The whole question needs more definite investigation. It is certain that the cows have continued to give milk while working.

Even if we admit that working the cows will result in some reduction in milk yield, it may still result in an increase in the yield of or amount of milk actually available to the villager. Now he gets none from his bullocks. If he gets some from a pair of cows, whatever he gets will be an increase over what he now gets.

It is not suggested that high yielding cows from existing dairy herds be put to work; rather the suggestion is that the low yielding cows not good enough to justify being fed and kept as dairy cows be used. They are now the source of most of the cattle reproduction in the villages. If they do the work and continue to produce the necessary calves to maintain the required number of animals, we have lost nothing. If the males are disposed of in any way, so that the pressure on the fodder supply is decreased, we will have gained that much. It is possible that the slightly better feeding made possible in this way will somewhat increase the milk yield. Having an objective reason easily evaluated for doing so may quite likely be an added incentive to the villager to do selective breeding resulting in a fairly rapid improvement in the cattle of the village.

RURAL DEVELOPMENT IN MEXICO

By

Lee Cowgill

(*Editor's Note* :—Many readers of the Allahabad Farmer remember Mr. and Mrs. Ira Hatch. For fifteen years Mr. Hatch was Farm Manager at the Agricultural Institute. Last July, the Hatches went to the Y. M. C. A. Rural Development centre at Tepoztlan, Mexico, to serve there for a year while Mr. Hatch's brother, Dr. D. Spencer Hatch started a new centre in Costa Rica.

The following very interesting letter has just come. It was written by an American visitor to the Centre at Tepoztlan. We are printing it in *The Farmer* both because of its news of the Hatches, and because of the sound Principles of Rural Development which it describes.)

El Centro Rural de Camohmila
Tepoztlan, Morelos, Mexico
February 14, 1948.

Dear Margaret,

We are so happy that you sent us the clipping about "El Centro Rural de Camohmila." A few weeks ago we came here for two days and were so charmed by the beauty of the place and so interested in the project that we are back again, this time for ten days. Spencer Hatch and his wife, about whom the article you sent was written, are no longer here. They left last year to go into rural extension work under the Pan-American Union with headquarters in Costa Rica. His brother, Ira Hatch, and his wife are now in charge of the project. He also, has studied agriculture at Cornell University, and he and his wife have had long experience in rural work in India. We are much impressed with the work they and their splendid colleagues are doing, under the Mexico City Y. M. C. A.; and I want to tell you about it. As the article you sent said, this experiment was iniciated in 1942.

Some one said the other day that the Rural Center is like Noah's Ark with two of every kind of animal. That statement is more picturesque than true, but they do have some highly bred animals—pigs, cattle, sheep, goats, chickens, and so forth, not for the purpose of building up fine herds or flocks that will bring in large amounts of money for the Center, but as a demonstration to the people of the villages about

here. A villager may borrow a bull, or a ram, or a cock, for instance, and take it home for the purpose of improving his breed. One day this week I was calling, with Mrs. Hatch, at one of the tiny houses in a village and a handsome Plymouth Rock caught my eye. I was told he was from the Center and was there for the purpose of improving the flock. The fine Jersey bull has just returned from a village over the mountain.

Every day that I am here something happens that makes me see how this job is done. Today a man came a way across a mountain to sell some barley. Perhaps this man had been worrying about his children who did not seem to be doing very well. Perhaps that is the reason he brought his barley —I don't know. In any case, before he left he had told Mr. Hatch about his children and another bargain was made. He was to have a nanny goat and her kid in exchange for some of his sheep. Now the children can have milk. Mrs. Hatch has a clever way of showing the value of good chicken in peses. She buys eggs from all the countryside and sells them without profit to the city folk. She has an egg scale on which every egg is weighed. Small eggs bring the regular price; and large eggs considerably more. These facts speak for themselves to the keen minds of these country people. When the women's faces fall because of the few centavos which they receive for the little eggs, they are offered the large eggs produced at the Center for hatching, in exchange for the small eggs, at no additional charge. The women are not only given the incentive for better chickens but are also given the means to the end.

The bees interest me very much because I never tasted such honey. It tastes of the many beautiful wild flowers of this district. The Center has demonstrated that the use of modern hives makes it possible for the bees to produce about three times as much honey as can be produced in the boxes generally used; and it is of a finer quality. Mr. Hatch is off today helping a country school teacher who became interested in this demonstration and began raising bees as an avocation. He can now make more money each year from his bees than from his teaching and the neighbors know it.

The Center has a good-sized garden plot. Most of the vegetables are sold to the workers and other neighbors with the hope that they will enjoy the fine quality and the new varieties so that they will enjoy the fine quality and the

new varieties so that they will want similar gardens. The Center sells seeds at a price that the small farmers can afford to pay. Gradually, the people are coming to like the new varieties; and the Center is happy when the people substitute soya and the big grey bean and the bush pea with 50% more protein for the beans they ordinarily eat. The usual diet of the rural people in Mexico is very low in protein.

Garden pests, as well as the northern tourists, seem to like the Mexican climate. Mr. Hatch tells me there are more and more persistent varieties here than in any country he knows, and he knows a good many. In a way he likes these pests because they give him another of the kind of opportunities he is always looking for. In cooperation with the Rockefeller Foundation he works in experimenting on the control of these pests. When he finds what is effective here, he passes the information on to his neighbors who have neither the money nor the ability to make the experiments. His tomatoes, which are ordinarily attacked by a number of pests, are showing some fine specimens of healthy vegetables as a result of his painstaking daily use of the spray. That man is a perfectionist as a scientist has to be.

Yesterday I was surprised to see the young students, under Mr. Hatch's supervision, digging trenches in the newly plowed field. I was surprised because to my untrained eye, the field looked level. On questioning, I got this interesting stoiy. The reason that the campesinos who owned the land were willing to sell it to the Mexico City Y.M.C.A. six years ago, was because it had not produced anything for years and was considered well nigh useless. The soil was packed and hard. A friend in Mexico City sent a tractor out to plow it. Before the heaviest rains came, it was seeded. My humiliation at not being able to see the slope was alleviated when I heard that the experts did not see it either at first, but were convinced when the first very heavy rains washed gullies and brought many of the seeds and plants to the lower end of the field. A demonstration in terracing is very important in this country which has to raise so much of its food-stuff on slopes and even on mountain sides. The Mexicans have a graphic word to describe this land which can only be translated as "brutal". This year, barring accidents, there will be soya beans and other soil and body-building crops for "all the world" to see and profit by. Thus is patience of the scientist finally rewarded.

To me the most encouraging phase of the work here is the student project. Boys come "from an hour or two over the

mountains" and from farther villages where there is no school beyond first grade. The students are boys who desire more education than is available in their villages, who give promise of ability to make use of this specialised education and who are willing to carry their share of the work, at the Center. These boys live at the Center and, during the week, attend the public school in Tepoztlan which takes them through the six elementary grades. An hour before they start off in the morning and an hour after they return late in the afternoon and all day Saturday they work with Mr. Hatch and his colleagues, learning by doing and helping to pay for their well-balanced meals. Mr. Hatch has such a fine philosophy and he is so sincere and ethical and devoted to the boys that I am sure they gain much besides improved agricultural methods from him. In addition to learning how to plant seeds in the earth, it is enevitable that seeds are planted in their minds and characters, which will bear fruit in their man hood. The boys are under the supervision of a young Mexican whose family moved to California when he was very young. He lives in the student house where the older boys sleep. This house was built by a group of college students from the United States who were working under the direction of the American Friend's Service Committee. I asked Leo, as he is known to everyone, how he happened to return to Mexico, and he told me this story.

"Always when I was studying about different countries, I dreamed of travel and of living in the great cities of the world. I suppose I pictured myself as being in every country except Mexico. That was one country I hoped never to see. My father and mother had left Mexico at the time of the last revolution. They didn't have much good to tell of the country. The day I graduated from high school this suddenly changed I knew I wanted to go to Mexico to work in some rural community."

"You must have gotten a vision like Paul," I said.

His face lighted up until it was beautiful, and he said, with his contagious laugh, "Well, I guess I did—or it got me."

Seven years ago, at seventeen, he came to Mexico against his parents' wishes. He was poorly equipped as to language training, and experience. He came to the site of the proposed Center and was offered a position with the new enterprise. With the wisdom that seems to be a part of his innate equipment, he refused because he knew he needed more direct

experience with country people before he attempted a position which required leadership. He became a teacher in a village "three hours back from the highway". He married a beautiful girl from the village and this year he has joined the staff of the Y.M.C.A. Rural Center here at Tepoztlan.

We sleep and have breakfasts with the Hatches, but we have dinners and suppers with Leo and his wife. Sometimes the boys are there for the meal; and they always come in after supper for an hour or so with Leo. He gives them their instructions for the following day, then reads a chapter from Pinoccio to them. It is fun to watch their alert faces and hear their quick, hearty Laughs. Leo says that being read to is probably an entirely new experience for them. They are intelligent and promising youngsters, and I like to dream of what they will do for the people in their villages during their lifetime. The first student who came in 1945, braving the warnings of his neighbors and the disapproval of his parents, completed the school in Tepoztlan and has just entered the Government Agricultural School at Puebla.

Mrs. Hatch is also having a very strong personal influence. She is much loved. I like to go with her to the villages. Her ostensible object is to buy fruit and eggs. It is considered polite to ask where one is going and why. I understand that this custom dates back to early Indian folkways. So Mrs. Hatch, or the Senora, as she is called, always carries her basket and always shows her purchases on her way back. However, she has in her mind something else that she wants to accomplish. May be it is to try a little persuasion on a father who thinks the two years regular school is enough for his bright daughter. Perhaps she wants to see how the Cock from the Center is faring or to tell a beekeeper of the many advantages of modern hives. She is straight and honest in her relationships, and one can readily see that she is trusted by these men and women who are slow to trust a stranger.

The Center has always very wisely held to the practise of having people pay for all the tangibles which they get. Those in charge realize that if they begin giving things away here, the proud and self-respecting people who are in the majority would not come and the few who are inclined to dependency would tend to become more dependent. It is a very hard rule to hold to where there is much need and the workers deserve great credit for keeping always in mind

that what they do must be done to have a lasting constructive effect.

Then there is the "noon day school". In spite of the efforts that the Mexican government has made since 1930 to see that education is available to everyone, there are still many illiterates and many of those who have had a year or two of schooling are eager to learn more. When any workers ask for classes—Spanish, English, reading, writing, arithmetic, sewing, cooking, etc.,—enrollments are in order. Any worker may be excused for his task for the last hour of the morning; and neighbors near enough to come are invited. Many of the homes are justly proud of the framed certificates which have been given to one or more members of their families after they completed these short courses.

This letter has grown out of all proportions, and I have not told about the health nor the canning nor the weaving projects. All of these are so constructive and so interesting that I will beg for your patience for a little longer.

The Center employs a good nurse with much hospital and community experience and with a wonderful personality, which includes a sense of humor and much of that other kind of sense which is so mistakenly called common. I just took a picture of her on her horse, a spirited animal that insisted upon standing on his hind legs to have his picture taken. Night and day she and this horse are ready to answer any call from people in these villages where there are no doctors or nurses with scientific training. The second night we were there, she dropped into the Hatches' home, which is the dropping-in place for everyone far and near. She seemed tired but denied that she was. She had just come from a home where she had brought a baby into the world, her third in four days. She also has a clinic at the Center where people come in with all sorts of ailments, mostly minor. Senora Piedad as she is called, is wise in recognizing when a case should be referred to a doctor or to a hospital. Twice a month volunteer doctors and aides of the Mexico City Y.M.C.A. spend a Sunday at the clinic, in the villages and in the director's home, giving talks on the prevention of diseases and accidents and on child care and prenatal care. Senora Piedad has the benefit of their counsel and she keeps in touch with their patients who need it until they come again. The leaders at the Center consider that this is only a beginning in health work, but they are fortunate to have such a person as Senora Piedad to make this directly needed and most worthwhile beginning.

Dona Ana is in charge of canning and preserving and the straining and bottling of honey. She, like the others about whom I have told you, is an interesting person. She left Mexico for the United States when she was less than a month old, and she had her education in Colorado. She and her husband (also an important member of the Staff) and their five delightful daughters live in the "better house". They refuse to call it a model. It is built of adobe, as are all the buildings at the Center. It contains inexpensive and easily obtainable improvements over the usual village house: such as a scrubbable floor instead of none; a simple but effective shower bath; a flue for keeping smoke out of the eyes of the housewife; and a corn grinder to save many hours daily of grinding with one stone on another. Then, too, the house has a "better yard," with a sanitary bore-hole latrine (that can be dug at no cost beyond the labor) and a simple model chicken house and yard. The material for the house cost less than $100 (dollars) when it was built about three years ago. Many of the farmers around here could accumulate that much capital, especially if they adopted the improved farming techniques which are being demonstrated at the Center. The men can build their own houses in the long, dry season when there is little work to do.

Under Dona Ana's careful supervision several thousands of jars of jellies, jams, pickles and chutneys are preserved every year. Fortunately one fruit follows another right around the calendar year—bitter oranges at the moment; then wild blackberries, mangoes, peaches, and guavas. The native oranges had been allowed to go to waste because they were too bitter to eat raw. The Center has helped the people to save them by making them into bitter marmalade—and is it delicious! Even your epicurean taste would approve. Now the people can sell their oranges; and they can learn to preserve them at the same time. Yesterday when I was in the Community Kitchen, a local woman was working with Dona Ana, preparing her own oranges for marmalade. She is learning partly so that she can add to her income by selling preserves, and partly so that she can preserve for her own family. The Center sells its fruit products, as well as its honey and that of the neighbors who have adopted modern hives. Most of these canned goods are sold in Mexico City.

Now for weaving. Weaving is an ancient craft in this valley, but the sheep were all killed off for food for the conquering armies during the revolution of 1910, and the people had to give up their looms. The Center is doing all it can

to encourage the raising of the more profitable, pure-bred sheep ; and it has quite a herd. The wool from these sheep is cleaned, carded, spun, and woven into serapes, rugs, and blankets. The boys and girls, men and women have real confidence in the weaving master who loves the profession in which he has been engaged for twenty-five years. They are paid a very small amount a day at first, but they can make a living after they have studied with him for varying periods of time. Those in charge of the Center feel that the greatest opportunity is for farmers and their families to have looms in their own homes and to make their own blankets and serapes and shawls during the long dry slack season, preferably from wool from their own pure-bred sheep.

I have tried to tell you the whole story of the Center, but that seems impossible because every day I learn of more activities and phrases of the self-help programme. Further, I have had to be very sketchy in what I have written. The leaders are not trying to change these substantial, reliable, likeable, dignified, people with their centuries-old love of the soil. They are trying to show them how they can make the soil produce more adequately, so that they can live more abundantly. They are doing what we failed to do with our American Indians. They are cognizant of the innate worthy qualities of the Indians which ought to be preserved, but they want to help them make use of that of modern culture that can be advantageously built on their ancient civilization. This does not mean that they want to introduce automatic washing machines and bathtubs which we estimate so highly in our evaluation of civilization. How stupid we are to think that these things are essential for beautiful living. I felt beauty in living when I went into a tiny two-room house. Here was very primitive living with the little charcoal fire, the tortillas being made from the corn taken out of the round cane built store house which took up most of the space in the second room. The wife and mother squatted on the dirt floor while she rolled the corn. There were no beds, only straw mats rolled up in the corner during the day to be spread on the floor at night, and serapes thrown over a pole —no chairs. I understand from Robert Redfield's scholarly book on Tepoztlan that many of these homes probably show little change from the homes of the ancestors of these people who lived here before Columbus took his adventurous journey across the Atlantic.

The simplicity is beautiful, but it makes the struggle for health or even more existence too difficult. What a help it

would be if the family could install easily obtainable improvements such as windows for light, a floor that could be kept clean, and sanitary measures including a borehole latrine. No one at the Center has anything in his home which would complicate that home life, or that ought not to be within the reach of most of the people living in the surrounding villages. There is not a bath tub on the place and no electricity and no telephone and no ice. But all live healthfully and with a certain almost primitive beauty. Their homes (which are all public buildings, as the wide-open doors and the ready, hospitable "pase" welcome people of the villages any time of day or night) are of course, clean and healthful ; and they also show an awareness of essential contributions of modern art and culture.

The process is slow and no one will ever know how much contribution this experiment has made as modern Mexico develops. But any effort that builds idealism so securely and soundly into the lives of a community must have its effect. The pity is that the same kind of work cannot be carried on in hundreds of communities all over this country where changes from the primitive to the modern is so evident. I am told that this was the sentiment also of ex-President Cardenas who was a recent visitor.

I have not checked on the reading time of this letter. I trust it has not worn you out. I also trust I have given you a little picture of this fascinating experiment with human beings.

Cordially,
Lee Cowgill.

OBSERVATIONS ON WEATHER AND FUNGI AT ALLAHABAD IN 1947-48

By

E. F. Vestal, Ph.D.

The temperature, rainfall and humidity of the kharif and rabi seasons of 1947-48 were much more nearly average than for the same seasons of 1946-47. Tables I, II and III are given for comparisons. In the 1947 report (2) it will be recalled that attention was drawn to the somewhat unusual behaviour of certain of the common crop fungi. Stipe rust, for example, was not observed at all on wheat in the vacinity of Allahabad. But pea rust (*Uromyces fabae*) and lucerne rust (*Uromyces striatus medicaginis*) were unusually severe. Downy mildew (*Peronospora trifoliorum*) was also severe locally and in some cases defoliated the plants of the lower leaves. The mildew, together with the rust, caused appreciable loss to the leaves. Powdery mildew of the garden pea (*Erysiphe polygoni*) and of the cucurbits (*Erysiphe cucurbitarum*) were also serious. During the 1947-48 season only the powdery mildew of cucurbits caused the usual amount of damage.

A comparison of the rainfall and humidity records for the two seasons under comparison will show, that while there was actually more rainfall during 1947 than 1946, the distribution during 1946 was much more uniform and that the humidity during the months of October and November of 1946 was 9·74 and 9·55 per cent higher than for the corresponding months of 1947. This would give one reason for the difference for the presence of the fungi during 1946. October and November being the critical months for these fungi which are rabi season diseases.

TABLE I.

TEMPERATURE.

	1940	1941	1942	1943	1944	1945	1946	1947	1948	AVE.
January ..	..	60·78	59·26	66·07	60·54	59·56	61·91	58·01	61·40	60·94
February	..	64·64	64·80	63·14	62·54	63·19	64·34	63·09	63·10	64·23
March ..	..	75·95	75 60	75·92	73·70	..	72·45	76·19	72·77	65·32
April ..	82·10	88·20	85·25	78·72	81·78	76·50	85·06	86·88	85·33	83·06
May ..	92·05	94·00	93·70	91·82	83·80	90·20	89 38	92·65	..	90·95
June ..	93·72	89·60	94·34	92·88	82·65	84·30	87·93	91 02	..	89 55
July ..	83·38	86·40	83·75	85·60	86·95	85·90	86·83	84·40	..	85·40
August ..	83 19	83·70	82·28	80·80	81 83	86·32	83·30	83·40	..	83·60
September	83·45	83 20	81·72	83·50	79·45	82·75	83·00	83·18	..	82·53
October ..	80·30	80·10	78·50	76·84	74·62	75 92	75·90	76·77	..	77·34
November	69·48	67·63	68·23	67·89	68·38	65·66	68·00	70 40	..	68·20
December	63·00	62·22	60·85	61·28	62 60	59·70	63·24	58·20	..	61·38
Total ..	..	..	..	..	..	..	..	..	..	..

1947-48.

TABLE II.

RAINFALL.

	1940	1941	1942	1943	1944	1945	1946	1947	1948	AVE.
January ..	..	1·03	3·96	0·57	0·00	2 00	0·00	0·29	0·85	1·08
February	..	0·20	4·30	0·22	4·58	0 00	1 00	0·34	0 43	1·29
March ..	..	0·00	0·36	0 00	4 38	..	0 00	04 5	*Nil*	0·64
April ..	0·19	..	0 08	0 66	0·31	1·01	0·60	·*Nil*	..	0·35
May ..	0·14	0·18	*Nil*	*Nil*	*Nil*	0·10	0·51	*Nil*	..	0·12
June ..	0·80	2·74	4·52	0·80	1·09	1·21	3 69	3·04	..	2·24
July	4 37	5·72	7·10	8 29	8 64	5·62	10·60	14 57	..	8·11
August ..	14 72	5 28	9 98	19·78	19·04	11·65	12·61	10·14	..	12·90
September	5 60	8·65	8 22	8·78	4·98	1·29	2 91	6 82	..	5 91
October ..	0·12	0 04	0 00	0·74	2·09	2·92	0·75	0·78	..	·0 93
November	0·02	0·00	0·00	0·00	0 00	0 00	1 13	0·00	..	0·143
December	0·00	0·00	0·16	0 0	0 90	0·00	0 08	0·00	..	0·142
Total ..	..	23·84	38·68	40·24	46·31	25 85	33·88	36·43	..	..

TABLE III.

HUMIDITY.

	1940	1941	1942	1943	1944	1945	1946	1947	1948	AVE.
January ..	..	78·96	80·22	61·77	81·62	58·60	58·30	81·02	90 67	73·64
February	..	66·58	77·65	75 70	81·66	..	64·89	78·25	86·30	75·86
March ..	..	41·55	59 76	51·59	78·89	..	52 68	56 44	84 58	60·78
April ..	30·10	30·50	48·48	65·00	61·50	56·00	53 30	40·50	74·58	56 24
May ..	38·50	42·00	51·60	48·65	45·00	65 50	46·80	44·30	..	45·28
June ..	48·30	63 56	49·08	56 80	54·70	53·00	56 23	55 40	..	54·14
July ..	78·00	70·36	86·24	72 60	89 60	69 65	83·50	87·30	.	79·65
August ..	83·70	83·62	79·25	93·24	88·55	67·47	90·80	89·76	..	84·04
September	75·50	83 20	79·52	88·00	78·76	76·12	86·86	86·58	..	81·81
October ..	58·00	80 60	76·08	86 95	78 86	75·50	80 80	71·06	..	75·60
November	52·20	53·42	74 00	73·89	69·83	67·44	77·86	68·30	..	67·11
December	71·80	89·96	81·03	78·84	53·80	60·70	81·56	79·40	..	75·18
Total ..	..	..	..	..	..	..	..	..	..	..

During 1946 and 1947, as indicated above, stripe rust appeared only as a trace in 1947. Why it did not appear in 1946, with the rainfall and humidity ample for development, is still not clear. Weather conditions were not favourable in 1947 and it was not so surprising to find it appearing late and then only as a trace. The trace appearance occurring the latter part of January. Leaf rust did not appear until about the same time but leaf rust spread more or less normally over the area. Little damage resulted, however, as it came very late and the wheat matures before the rust could injure the leaf tissue. Stem rust did not appear until about the first week of February and this also was too late to cause more than a

small amount of damage. The low rainfall and humidity of October and November 1947 was no doubt responsible in part for the lateness of the rusts appearance. There was relatively little north-west wind during the early days of the rabi season and that, no doubt, was also a factor as spores were not brought from the hill country early enough to be able to cause an early epiphytotic.

In the case of the pea and lucerne rusts it must have been more the humidity than anything else. Lucerne was grown in the same field and peas were grown on an area which partly overlapped the field of the previous season yet very little lucerne rust was found and no pea rust. That the stubble, bearing the rust of 1946, could have been completely destroyed during the spring of 1947 is possible but highly improbable.

During the 1946-47 season anthracnose of papayas was common and caused some loss through fruit decay. In 1947-48 very little loss was observed. This may be associated with the humidity and rainfall more than we think at this time but the rainfall during January and February of 1948 was slightly greater than during the corresponding months of 1947.

The zonate leaf spot of sorghum was more severe than usual during the kharif season of 1947. This may have been associated with rainfall but if so it would appear that it was the heavier rainfall of September which caused the fungus to be more severe. Red rot attack on the leaves of sugar-cane was heavier than in former years. Red spot of jowae was about as usual but the sporulation was more abundant than usual. The same thing could be said of red rot on the sugar-cane leaves.

Potato tuber diseases were less evident than usual. Only a trace of Fusarium and bacterial soft rot was observed at digging time. All seed was treated with Spergon at time of planting and this may have had some influence although it is not generally believed that seed treatment carries any lasting effect to protect the new forming tubers from disease. An experimental layout of treated and untreated tubers did not give significant results at digging time. This was expected as there was only a trace of disease observed.

AGRICULTURAL ENGINEERING—ITS PLACE IN THE LAND-GRANT SCHOOLS*

By

ARTHUR W. TURNER†

It is always a pleasure to discuss the importance of Agricultural Engineering in our domestic life and in the world economic picture. The opportunity of presenting it to you is a special privilege which I greatly appreciate. By way of introduction and background, I am an Agricultural Engineer by graduation, taught on an Agricultural Engineering Staff, served nearly a score of years in industry as an Agricultural Engineer, and now am directing Agricultural Engineering research in the U. S. Department of Agriculture.

Engineers like to identify themselves according to the industry they serve. So, there are transportation, marine, automotive, electrical, mining, petroleum, and other kinds of engineers serving industry in its many phases. The agricultural engineers' industry is agriculture.

Agriculture is America's largest industry. It is a large user of power, labor, and materials. Prior to the war, American manufacturing and processing industry had 50 million horse-power available, while agriculture had 97 million. The 1940 census reported that 18·45 per cent of all persons gainfully employed were in agriculture as compared with 24·3 in all manufacturing. American agriculture purchases more than one-third of a billion dollars worth of building materials annually, more than three-fourths billion dollars worth of machinery and equipment, and over half a billion dollars worth of fertilizer, which is rapidly becoming a major commodity of the chemical industry. Agriculture is the petroleum industry's largest customer, while the immediate and potential consumption of electricity by agriculture is enormous. Now transmission lines provide power for more than three and one-half million separate farms, each with

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*Presented at the Engineering Education Section, Association of Land Grant Colleges and Universities, Washington, D. C., November 10, 1947.

†Assistant Chief, Charge of Agricultural Engineering Research, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. D. A.

EDITOR'S NOTE: "Land Grant Schools" is the term used in U. S. A. to denote Goverment Colleges which got their start, financially, from the sale of public lands granted to the colleges by Government.

unlimited applications of electric energy. Agriculture is big business, America's largest. Agriculture was the world's original industry and still is its basic industry, and as such deserves a goodly number of specially trained engineers.

WORLD FOOD NEEDS

The importance of food in war and in peace is recognized throughout the world. In the world economic and political situation recently much emphasis has been placed on food—food for a starving world. An outstanding Engineer, Herbert Hoover, former President of the United States, and Chairman of the President's recent Famine Relief Committee, made this statement on his return from a world inspection tour :

"Calories are the yardstick of hunger, of starvation, of famine, and finally death......As we descent the scale from the stage of hunger, to the stage of disease and epidemics, to the stage of public disorder, to the stage of starvation of all but the strongest, we come finally to the stage of mass starvation at less than 900 calories a day......Long before a population is reduced to these low levels, however, Government would break down. We must prevent the descent to these lower levels. Reconstruction and peace in the world would go up in the flames of chaos if we were to fail."

The importance of food as a stabilizing influence in the world was recognized by the formation of the Food and Agriculture Organization and ratification of its constitution by 42 nations at Quebec, Ontario, October 16, 1945, as a vital part of the U.N.O. Apropos of the importance of food in world peace, Sir John Orr, Director General of F.A.O. made this statement at the first plenary session of the organization at Washington, D. C., devoted to urgent food problems.

"The co-operation of Government in a common effort to free the world from hunger will do more for an enduring peace than the delineation of political boundaries and the drawing up of political peace treaties, essential though these may be. Famine is the greatest politician of all. Peace cannot be built on a *foundation* of empty stomachs."

I was asked to prepare a paper for the International Technical Congree held in Paris, France, in September of last year on the subject "The Impact of Mechanization on Agriculture." I raised the question : "Will this demand for more food be met by further mechanization ? Can other nations increase their production in this same way ?" I answered

these questions by saying, "Not by mechanization alone. Mechanization, as we know it in the United States, is more than just replacing hand methods by machines in crop production. It is Agricultural Engineering—applying Engineering principles to Agriculture in soil conservation, in farm buildings including both animal shelters and grain storages, and the efficient use of electric energy as well as mechanical power and farm machinery—all of which are dependent through management and are part of what, for lack of a better term, has been called 'farm mechanization.'"

I am now a member of a committee attempting to set up a procedure under the "Marshall Plan" to provide the 16 European countries with needed food production tools—farm machinery. This has to be determined very realistically for we in this country have increased our food demands by 10 per cent since the start of the war. Our population is 13,000,000 greater. And you people, burdened with present university enrollment, no doubt agree with the October 15 United States News charts showing that our population will be 150,000,000 by 1950. Every person is a mouth to feed and a body to clothe.

Can we increase our production to meet these additional demands? Some of you civil engineers will no doubt point to the vast areas that can be brought under cultivation through irrigation. Possibly this can be done to give us some increased production. But what are we going to do about the thousands of acres of fertile land that are being flooded to provide hydroelectric power and ruthlessly stripped for coal and other natural resources, the large areas being destroyed in oil fields, good soil used for fill in major construction, and the burying of good soil in covering dumps and similar areas. Will not this waste of our basic resource offset to a large degree what we gain through reclamation unless our conservation programmes are made more effective?

The alternative to increased production from more land is to boost our food and fiber production from the present cultivated area through advancements in science and engineering. Hybrid corn is, of course, the best example of how this can be done. That one advancement, which was made possible only through research, gave us 2 billion additional bushels of corn during the war years. Such production would not have been possible, however, had it not been for other developments, particularly in agricultural engineering, which made

possible the mechanization of many production operations, including precision planting and mechanical harvesting. The change from horse-power to machine power alone released many thousands of acres which became available for increased production of foods. It also increased our efficiency in many other ways. These changes were the result of research, both public and private, in the field of agricultural engineering. In this post-war period agriculture's research men are not looking backward; they are, instead, looking ahead at new problems that challenge the imagination.

SOME AGRICULTURAL ENGINEERING PROBLEMS.

Let me list a few of the questions now under consideration in agricultural engineering research:

1. What new equipment and changes in methods are needed in harvesting and curing hay? Dairy nutrition specialists say enough protein is now lost in handling hay to feed 7,500,000 dairy cows for six months. That indicates rather emphatically that methods now used in harvesting this valuable crop are awkward, inefficient, and antiquated. The development of new haying machines and procedures is largely an engineering problem.

2. What crop conditioning requirements and facilities does the producer need, so he can hold and market his commodities in top quality condition at his own convenience rather than to dump them on a flooded market at harvest time? This question opens up a whole field of engineering research that is relatively unexplored.

3. What are the economic factors involved in the production and decortication of new fiber crops, such as ramie, sansevieria, and others, on an industry basis? The present world shortage of fibers which is especially serious in this country indicates the pressing need to accelerate research that may lead to new fiber industries and establishment of our own fiber industries.

4. Can tobacco, cotton, peanuts, sweet potatoes, and similar crops be mechanized for quantity production and quality control? On many of these products the surface of the research that needs to be done has barely been scratched.

5. How valuable is the labor that is performed about the farm buildings in caring for livestock and crops? In dairying, for example, and in producing poultry and eggs,

up to 80 per cent of the labor time is spent in the buildings. The time required to care for one cow ranges from 100 to 165 hours a year with an average of 140 hours, while a flock of 125 laying hens and pullets will require approximately 200 hours. Compared with crop production these requirements are extremely high. What is needed in new machinery or equipment and arrangement of buildings and work procedures to reduce the labor needed?

6. How much does the producer pay for inefficiency in farm processing plants and small industries handling farm products, and what can engineering do to reduce costs? Output per worker varies as much as 25 per cent in creameries within boundaries of a county, 800 per cent in milk marketing, and 65 per cent in poultry processing plants.

7. What do we need to know about housing farm animals to lower costs of production, improve quality of product, and maintain the health of the animals? Engineers need scientific data on the heat and moisture production of the various kinds of animals in order to provide the right environment for high production and to protect the structures themselves from damage by decay and other ravages.

8. Can the potentiometer be used to supplant the seed germination test as a means for determining seed viability and growth characteristics? Some experiments have shown rather startling results and indicate this instrument may have untold value to the plant breeder.

9. Does anyone know or can any of us even imagine the potentials from use of bactericidal, erythemal, and infrared energy in agriculture? In this field of electric radiation preliminary explorations have already indicated a tremendous field for research of especial immediate interest on the possibilities of supersonic energy and its effects on plant, bacterial, insect, and animal life?

10. What types of refrigeration equipment for farm use will be required in the future? In so far as farm applications are concerned, refrigeration is just in its infancy. The possibilities of freezing fresh milk on the farm are, for example, just becoming known. In the not-too-distant future, also, poultry may be fresh-dressed, frozen, and sold directly from farms. With further research in farm refrigeration, the marketing of many perishable farm products might easily be revolutionized. Equipment to handle such demands has not yet been designed.

MANY ENGINEERING RESEARCH PHASES

Those are only a few of the problems of the moment about which agricultural engineers are thinking. In agricultural research it is sometimes difficult for many to distinguish the engineering phases because so often the work is set up by commodities—cotton, corn, hogs, cattle, or other crops or animals. In all these fields, however, there are engineering phases. This work might well be described as functional research because so often it deals with the functions of production, storage and housing, processing, and marketing. In Agricultural Engineering the investigations are concerned not only with crops and their production but also with the functional requirements of livestock shelters, the development of more livable homes, and the efficient use of labor and both mechanical power and electricity on the farm and in the rural farm industries. You will be interested to know that estimates have been made showing that 85 per cent of the nation's vast agricultural research programme has engineering phases or implications.

TRAINING OF AGRICULTURAL ENGINEERS

Recognizing that there is a need for increasing food production throughout the world, there must be a need also for more agricultural engineers, for they are in reality the engineers of food production. What background must such an engineer have? Here is a brief resume of some of the requirements:

He must, of course, be an engineer because he deals with power, labor, methods, and materials. He must also know farming and the problems of crops and livestock production, processing, and marketing. In other words, he must know agricultural fundamentals in addition to having the technical knowledge of the engineer who goes into any other industrial field.

The agricultural engineer needs a knowledge of soil tilth with regard to respective kinds of soils, climate, and crops. One might refer to this as soil physics. What is the nature and frequency of cultivation needed to control weeds and to stimulate maximum production in any given soil and for each particular crop? What are the possibilities of using chemicals, heat, and electric energy in weed treatment in the various field operations? These require a background of agricultural training for their solution.

The agricultural engineer also needs a working knowledge of plant science and a close relationship with the plant breeders. He knows the characteristics he desires in seeds or seedpieces for precision planting, and such characteristics as the type of straw or stalks desirable for harvesting. For harvesting, the ideal situation would be to have a universal machine for all crops. However, this seems impossible because of the wide variety of the present physical characteristics of the crops. Probably, however, individual machines can be adapted to harvesting a wider variety of crops than is now done.

Thousands of varieties of insects attack our crops and animals. The entomologists develop insecticides and fungicides, both liquid and dust, but they and equipment manufacturers have been stymied by lack of satisfactory methods and equipment for application, whether by ground or airplane means.

TRAINING BY LAND-GRANT COLLEGES

How and where should the agricultural engineer be trained? Here I am giving my personal views, based on observation of engineers in all branches of agriculture. The logical place for training is the land-grant college having both engineering and agricultural staffs. Possibly there are exceptions; however, I am sure you will agree with my first statement. The agricultural engineer needs a strong agricultural engineering consciousness that will enable him to understand and apply engineering principles to agriculture in a scientific as well as practical manner. Every state can and, I believe, should have at least one strong agricultural engineering department.

Personally, I do not fully subscribe to four years of engineering training and one year of agriculture, or four years of agriculture and one or more years of engineering. Neither procedure developes a proper agricultural engineer consciousness. Instititutions having a 4-year curriculum in engineering should have a 4-year curriculum in agricultural engineering.

The administration of agricultural engineering training—and here is where I again open myself to questions from some of you—to my thinking should be a joint responsibility between the Dean of Engineering and the Dean of Agriculture. The engineering requirements of agriculture are a combination of engineering fundamentals and agricultural fundamentals. They are not the so-called trades of skills but

the basic fundamental requirements of the two professions: one without the other is apt to result in lopsided training and subsequently lopsided viewpoints.

It will not be sufficient in developing the agricultural engineering curriculum to reshuffle the present engineering and agricultural courses and expect the agricultural engineering student to sift out the wheat from the chaff. One of the handicaps in agricultural engineering training today is insufficient text materials and teaching examples of engineering applications to the agriculture. It is essential to study not only the overall curriculum, but also to organize some special agricultural engineering courses. This applies to both engineering and agriculture. Take the applied mechanics of field machines for example. Agricultural equipment does not have the solid foundation of the power-generating plant, the steel rails of trains, or the concrete roads necessary for operation of motor vehicles. Instead farm machines operate over uneven terrain. Power is transmited at angles by sprocket, shaft, belt, and chain, and through the power-take-off, and the angles change in both horizontal and vertical planes while the machine is in operation, either to meet terrain irregularities or crop requirements.

Another example includes farm buildings which represent a large part of the farmer's investment and affect his income in several ways. Where climatic conditions are unfavourable the amount of milk or eggs that a farm produces is likely to depend on the capacity or the convenience of the buildings. Storing the various crops is dependent on the conditioning requirements of each crop; how much moisture is transferred from the center of a kernel or seed to the surface where it can be evaporated or removed. Controlling or eliminating moisture migration in grain storages is another essential in grain storage design.

Specialized courses in engineering and especially in agriculture could concentrate much essential materials into fewer and more useful courses. For example, take the material on soil physics already mentioned. One good course on soil physics could cover soils if presented as related to the structure of soils, characteristics which affect tillage, traction, erosion, and similar factors. Livestock should be studied from the standpoint of housing and care instead of merely judging individual animals. Field crops should be studied from the mechanical standpoint for production and agronomic standpoint for storage and utilization.

Another course which I believe should be in every engineering curriculum has to do with the engineer's responsibility for developing and understanding the economic and social phases of his work. One of the greatest dangers to our constitutional form of government and our free economy is the lack of appreciation of how these two great institutions serve everyone and have provided us with the highest standard of living ever achieved. Again and again in meetings and papers of our engineering societies it has been emphasized that the people responsible for high standards must also assume responsibility for translating and publicizing just how our system operates. Our responsibility as engineers is to correct misunderstandings about our economic system, and thus to stop the dangerous undermining which has been going on in some quarters.

The training of the agricultural engineer has the same relationship to agriculture as that of the mining engineer to mining and the aeronautical engineer to aeronautics. It is an engineering profession serving the agricultural industry. That industry, in many of its phases, calls for the highest type of engineering, a far advancement from its beginning as farm mechanics. Its true importance stands out in bold relief.

And now in conclusion permit me to ask your counsel on how our training and applications of engineering can be strengthened. Increasing numbers of young men feel a responsibility in applying engineering to agriculture. Many agricultural engineers are already doing yeoman service. Both deserve the benefits of state licensing now provided other engineers. We request your continued cooperation in seeing that this is realized in every state. You can be of invaluable aid in this as you are in the other engineering professions. It is most gratifying also to see that nearly every college engineering group offers membership in honorary organizations to agricultural engineers.

The agricultural engineer has contributed, if not led, in engineering of agriculture—which not only reduces man-hours in crop production, but also reduces losses in productions, provides storage for commodities, increases animal production though proper housing, and above all save the productive soil which is basic to the life of a nation. The world's increasing need for food has emphasized the need for better trained agricultural engineers—that more food can be produced for all peoples—thus removing an important age-long disturber of world peace.

THE FARMER'S CREED

"I believe that the soil which God made is our greatest natural resource ; that the proper conservation of its fertility and the maintenance of a good home upon it are my most important social services as a farmer. I believe that work upon the soil is a co-operation with the Creator in a complete, yet ever continued, creation ; thát it is the oldest most useful, honorable and enjoyable employment of man ; and that when undertaken in the right spirit it calls forth the best that is in him. I believe that better farming should mean better living ; that its most valuable product is the character it develops in the farmer, and that its greatest rewards are the satisfactions it gives"

—EDWARD J. RULIFFSON,

Progressive Farmer, November 5, '27.

I AM A NEW IDEA

By Carl C. Seitter.

I am a new idea.

I am not new to the world, but I am new to you.

Because I am new, you may want to look upon me with some reserve.

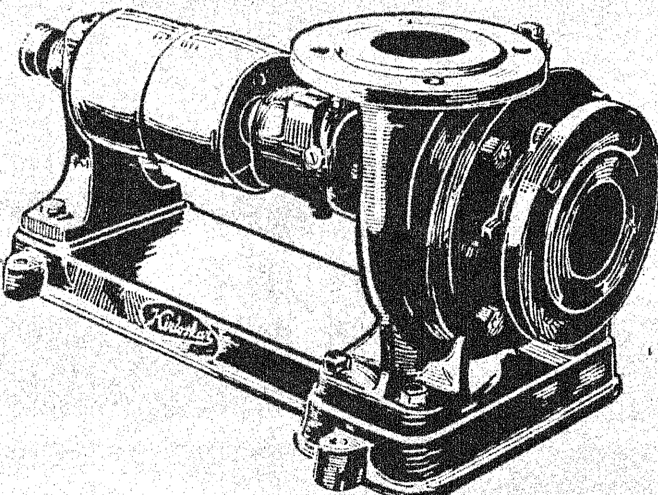
When I have once come into your mind and have set up my lodging there, you will have to readjust all of your thinking, for I will disturb any smug little system you may have.

I call for action. You can set me aside if you will. But as long as you give me place in your life I will haunt you with the desire for action. I håve made kingdoms fall, and caused new civilizations to arise. I have released thousands from bondage, and opened unsuspected doors to Traditionalists hate me ; the privileged fear me ; the powerful fight me. What care I?.

When my time has come, I shall rule.

I am a new idea.

From the Epworth Herald, Chicago, July 17, 1937.



Published by :—The Allahabad Agricultural Institute, Allahabad, U.P. (India)

THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL

OF

AGRICULTURE AND RURAL LIFE

CONTENTS

Vol. XXII MAY, 1948 No. 3

The Rains Have Come

The rains have come !

For days and weeks and months.

The earth, dry, parched,

Has opened her mouth toward a brazen sky.

The sun, a fiery orb,

Has mercilessly run his daily course,

Giving no heed to the panting earth,

But at long last, in blessing,

Soft raindrops, one by one,

The parched earth caress ;

And throbbing, sobbing,

The glad, good earth receives,

And bursts forth in a grateful song of praise.

The rains have come !

EMMA K. ZIEGLER

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THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL OF AGRICULTURE AND RURAL LIFE

The ALLAHABAD FARMER is now approved by the Directors of Public Instruction in the United Provinces, Bengal, Central Provinces, Sind, Assam, Bihar and Orissa, the Rural Reconstruction Commissioner, Punjab, and by the Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to Rajputana and Central India States, for use in all schools under their jurisdiction.

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The ALLAHABAD FARMER is published in the first week of each alternate month commencing with the month of January. Contributors are requested to send in their articles at least one month prior to the next prospective date of publication.

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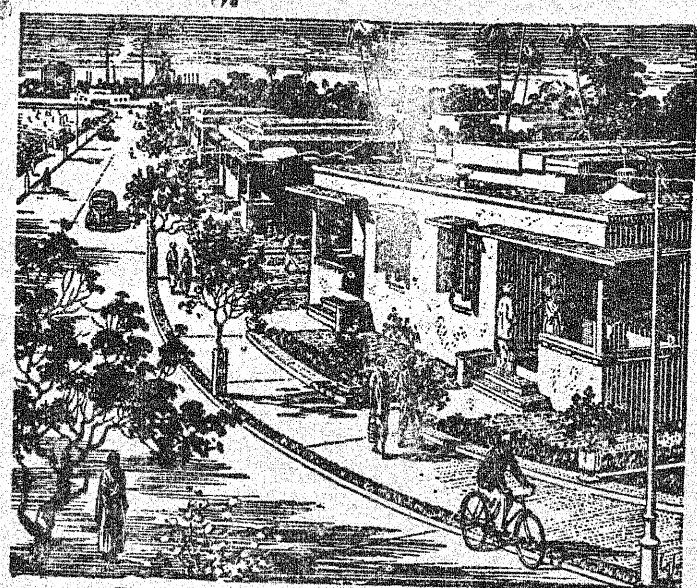
Publisher—The Allahabad Agricultural Institute, Allahabad, U. P.(American Presbyterian Mission).

Printer—The Mission Press, Allahabad, U. P.



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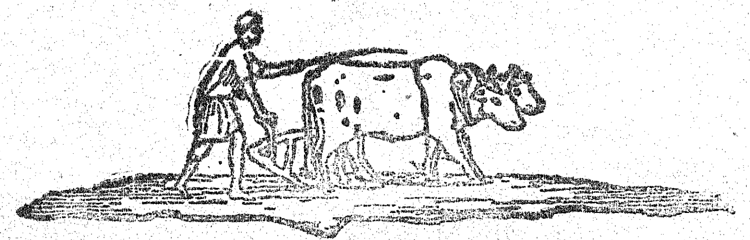

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COMFORT COOLING IN INDIA

By

M. Vaugh, Agricultural Engineer.

Man has always been plagued by the weather. We are rarely entirely comfortable. The weather is always just a little too wet or too dry, too hot or too cold for some of us and is usually so for most of us. In recent times, men have found ways of controlling the weather of small enclosed spaces, buildings, quite exactly in all respects. The general process of controlling the weather has come to be called "Air Conditioning" a term which means the control of temperature, humidity and air movement, three factors in comfort.

Complete air conditioning is expensive and hardly available to most people. Some parts of the process have been known and used for a long time. Air movement is ensured by using fans, restricted by closing up houses. Humidification and cooling have long been secured in India when conditions were right by the use of the "khas-ka-tattie." Dehumidification and cooling below the wet bulb thermometer temperature means relatively expensive refrigeration machinery and power to operate it. Wet bulb temperatures—the temperature to which a thermometer will drop when its mercury bulb is covered with a thin wet cloth and it is placed in moving air—are low enough to give comfort in the hot dry season of North India. They are of little avail in the humid rainy season because the humidity is high and there is little cooling effect from evaporation of water at that time, mainly because little evaporates.

Complete air conditioning is too expensive for all but the wealthly at this time. The ordinary khas-ka-tattie is quite effective when conditions are right, for the few hours that the wind blows. In many hot seasons there is little or no *loo* at any time and there is rarely or practically never any at night. In addition, the khas-ka-tattie involves having some-one stay outside in the heat in order to provide comfort inside. Something better is needed, something which will be available at wish day or night, something which does not involve the irritating and otherwise undesirable relations of a servant to operate it constantly. This is possible with a simple type of evaporative cooler.

What is involved in an evaporative cooler? An evaporative cooler is some mechanism to pass a large volume of air over a large surface of water so that the water may evaporate, absorbing latent heat of vaporisation from the air. The *loo* provides the air movement and the wet khas provides the large area of water. If we substitute a suitable fan for the *loo* and some automatic means of applying water to the khas-ka-tattie, we have a simple evaporative cooler. The principle is not difficult to understand and the arrangement is not difficult to set up, given the needed equipment. Many reasonably ingenious laymen, possibly with the help of a reasonably clever mechanic, can improvise one.

First, what sort of fan to use? The type known as a "propellor" fan is the simplest. It should have a large capacity to move air. It should run at a medium or low speed to minimise noise. The blades may be either mounted directly on the motor shaft or they may be on a countershaft which is driven by a V-belt (like a motor car fan belt) from a motor. For anything like effective use, in a large room, the fan should be not less than 24" diameter if directly mounted on the motor shaft and larger, 36" to 48" if driven at a slower speed by belt. This means that it is not possible to make a satisfactory evaporative cooler with a table fan. If more than one room is to be cooled, or if the room is very large, a proportionately larger fan will be needed. This, however, is likely to get into the circumstances where the plant should be designed by an engineer trained to the purpose and to cost more than the ordinary private individual can afford. The type of fan most suitable for the ordinary installation is what is known as an "exhaust fan" or an "attic fan."

What about the khas-ka-tattie and the method of applying water to it. The ordinary type of khas-ka-tattie is very

good when well made, properly fitted into a door and properly kept wet by hand. It has not proved very satisfactory for automatic wetting. Even when flooded with fairly large amounts of water from the top, the water tends to channel and to leave some areas dry. Water applied to the whole surface by a fairly coarse spray is moderately satisfactory but requires pressure to work the sprays. The long thin wood shavings used to pack breakable articles (known as "excelsior" to Americans) when loosely packed in a frame between two surfaces of tightly stretched "chicken wire" or light expanded metal works very well when water is trickled on to it from a perforated trough at the top. It however tends to become musty after a little while and is not always available. I have not seen it tried but possibly ordinary khas roots might be used the same way, in a thinner layer.

The amount of water applied must be more than just enough to moisten the tattie. The surfaces must be wet which means that water enough to trickle down and run off the bottom must be applied. If a piped water supply under pressure is available cheaply, this is not difficult. If water must be economised, the water must be recirculated. For very small installations this can be done in the daytime by having the water caught in tubs or tanks and carried by hand to the top dispenser. For really satisfactory operation, it is necessary to have some pump arrangement which will automatically return the water from the bottom of the khas-ka-tattie to the reserve supply at the top. A variety of small pumps are now available in some of the larger towns with the salvage dealers who have broken up old motor vehicles and similar things. They will usually have to be belt driven at a slow speed or at a suitable speed. It is desirable that they be installed where possible so the water runs into them from the tank at the bottom of the evaporator. This is essential if the pump is a centrifugal type. Recirculating the water will not only save water but will increase the cooling-effect somewhat as the water applied will already be cooled. Provision must of course be made for replacing the water evaporated while in operation.

The way the fan and khas-ka-tattie is installed is important. The fan should be installed in a baffle or board which completely closes the door or window in which it is placed except for the opening for the fan. There should be an appreciable space between the fan and the khas-ka-tattie, more for a larger fan and khas. A fan having a blade sweep

of 24" should have a khas at least 4′ square and the space between should be not less than 18". Either a door or a window may be used for the installation.

It is essential that the khas be outside and that outside air be drawn through it and discharged into the room to be cooled. It may be in a verandah or even in a room provided the room in which it is installed is entirely open and air has entirely free access to it from outside. Recirculating the air inside a room through such an arrangement will only result in raising the humidity to about 100% and in very little cooling effect. Since a fairly large amount of air is forced into the room by the fan, there must always be a free passage out of the room for the air. This should be a window or door at least as large as the one in which the fan and khas is installed. The fan may be on any side of the house and the discharge opening may also be in any direction, except that it is not desirable to use a door or window into which the *loo* is blowing strongly at the time as the discharge opening. The efficiency of the arrangement will be increased if the prevailing wind is in such a direction as to aid the fan and the outlet for air is on the leeward side of the house. Different outlets can be used at different times or even at the same time.

Some actual experience with a cooler in India.

For various reasons, my wife and I decided not to go to the Hills in the summer of 1947. We were able to secure the use of a 24" exhaust fan installed in a box with a khas arrangement approximately 48" square and made of excelsior. Our bedroom had two windows about 3′×3′ high up and opening into an upstairs verandah. The bedroom itself was some 18′ square and slightly more than 20′ high to the ceiling. Water was supplied to the arrangement by a house pipe connected to the Institute water supply. The water was regulated to use as little as would keep the mat wet and the drainage was allowed to run away to the garden. No arrangement was available at that time for recirculating the water. The bedroom opened to the South-East with a bath-room to the South-West, another bedroom to the North-West and the dining room and living room opening off the North-East side. Electric current and water supply were available 24 hours a day and only minor, if any, stoppages occurred. The arrangement was temporary and rather improvised.

The installation was arranged and started about May 20th and ran till the beginning of July, a period of about 6 weeks.

During this time, the fan ran continuously when one of us was in the house and was only stopped for a few hours during the time. No trouble was experienced with it. The particular fan we had was rather noisy but somewhat to our surprise, we very quickly became accustomed to it and in fact rather missed its masking of other outside noises when we stopped its use. No careful record was kept of conditions but we did have a thermometer in the room and the temperature was noted several times a day on most days. At no time, day or night, did we find the temperature above 85° F. Usually it ranged between 82° and 83°. We did not observe it below 80° during the period. For most of the time, the general effect was quite pleasant in the room. There was no feeling of clamminess and no tendency to become musty in the room. A light cover was generally needed for comfort when sleeping, either in the day or at night. We slept inside the room with the fan working throughout the period. We had no trouble with colds, cough or other symptoms. The room being screened, we were able to sleep without nets throughout the period.

We turned the outlet from the room in which the fan was installed according to where we were at the time, when not in the room. When bathing and dressing, we closed the door to the dining room and opened the bathroom door. When eating, we closed the other side and opened the dining room outside door so the air from the bedroom passed through the dining room. The capacity of the fan was not enough to fully cool the dining room but it did materially help when we tried to turn it through the dining room and living room, the effect was small in the living room. To adequately cool more than the one room would require considerable more fan capacity and a corresponding increase in khas area. Alternatively, several smaller rooms of approximately the same floor area and cubic contents could probably be handled by a fan of this size and capacity.

"Can I use one and what will it cost?"

First, the arrangement is only available where there is continuous electric supply at moderate rates, and where water is available at least part of the day so that a reserve tank can be filled. If the water is recirculated, only a few gallons per day will be used.

Suitable fans are in short supply and relatively expensive, around Rs. 500 each. It should be possible to make a reasonably satisfactory installation for something like Rs. 600 at

present prices, which would quite adequately cool one large room or two or three connected smaller ones. Commercial units were offered on the market at around Rs. 700 last year but no information is available as to their capacity and construction. Careful enquiry on these points should be made before purchasing.

Operating cost will vary of course with the size of fan and the cost of current as well as with whether the cooler is operated continuously or not. The one we had was not separately metered but it is estimated that current consumption did not exceed half a unit per hour of operation. Many families accustomed to going to the hills may find that the saving on travel and rent for two years will pay the installation cost and operation for two years. Manufacturers and dealers will give the current consumption of the fans offered. If given an annual overhand, the fans should last for many years so depreciation should not be high.

"Where can I get one?"

I have no units for sale and cannot undertake to make installations. General Electric Co. (India) Ltd., Calcutta was offering various sizes of fans from stock in India some time ago. Doubtless other firms will also offer them. Fans considered for purchase should be carefully investigated as to capacity—air delivery per minute, as to suitability for continuous operation over long period and as to current consumption. Generally fans not less than 24" diameter of blades should be selected. Large slow speed fans are preferrable to highspeed smaller size fans of the same capacity. I can only suggest that those wishing commercial installations should watch the advertisements in the public press and that those who consider making their own units should consult with the suppliers from whom they have been accustomed to purchase equipment.

A good installation of high grade material will certainly give a large measure of comfort during the period from the beginning of the hot weather till the beginning of the rains. These units will be of no value for *cooling* during the rains. They *may be* used as *ventilating* units of course at any time. No experience is available but it is believed that the operation of such a fan, installed to exhaust air from the house and run at night, might add materially to comfort during the rains.

AGRICULTURAL DEVELOPMENT

By

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It has been stated by the popular Government that not even a single person will be allowed to die of starvation. This means that the State has now taken up the responsibility of feeding every citizen. To achieve this it must make agriculture her first concern. The only way to discharge this responsibility is to step up production of food by increasing the out-turn of crops already being raised and by bringing additional areas under the plough where possible. The second course is beset with numerous difficulties. The culturable wastes are there because either the climate of these places is such as to render them uninhabitable, or irrigation and labour facilities are wanting, or crops cannot survive the attack of wild animals. It has yet to be seen how far these difficulties can be removed. Of course a good bit of area around the houses of the people can easily be turned into kitchen gardens with some effort on the part of the development departments. How the scheme of kitchen gardening can be envisaged into practical shape has been given in my article on "Cottage Agriculture".

This note is intended to suggest ways and means to enable the present area to give better return. This can only be done by raising the standard of farming by placing at the disposal of the cultivator all the facilities that a modern state can give. Most of the holdings, almost everywhere in India, are uneconomic; and with fragmented and scattered holdings no programme of agricultural development can achieve success to the extent desired. Improved agricultural implements cannot be used in them. Considerable difficulty is experienced and expenditure incurred in watching the crops. Suitable arrangement for irrigation can not be made. A good deal of labour is wasted in transporting manure to the fields and the harvested crop to the threshing floor and so on. These and numerous other handicaps find an easy solution in consolidation of holdings.

Consolidation of holdings will greatly minimise village feuds and thus save a good deal of time and money wasted in litigation. It may inadvertently induce every cultivator to have his abode near the holding and thus remove congestion in the village and improve sanitation. There will also be greater facility for women and children to enjoy the open air, to the advantage of their health. In view of these and numerous other advantages, the Government should, at once, enforce consolidation of fragmented holdings through legislation. Such an act will be a land-mark in the agricultural development of the country.

The present system of bringing about consolidation with the consent of two-thirds of the land-owners of the village is meaningless. In most of the Pattidari villages it is rather difficult for such a large number of people to come to an agreement on account of party politics. Apart from this, most of the Patwaries, who find dissensions amongst the cultivators to their advantage, donot favour consolidation of holdings and indirectly discourage it. Once the importance of consolidation is realised, it should be brought into effect at once. The Patwari of the village, in consultation with the Headmen or Surpunches of the adjoining villages (at least 4 in number), should proceed to do it as early as possible. The Surpunches of the adjoining villages usually have intimate knowledge of the place and at the same time have no interest of their own in the area under consolidation. Once this (consolidation) is done, subsequent division of the holdings into areas of less than 5 acres should be prohibited. This can be done by giving the land to the eldest son, who should give the shares of the net profits to others according to the decision of the village Panchayat.

For making agriculture a success, other things which play important role are the following and suggestions made for improvement may be taken recourse to, without waiting for the consolidation of holdings :—

(*a*) Availability of manure.

(*b*) Irrigation facilities.

(*c*) Improved Seed.

(*d*) Good tillage.

A beginning has already been made towards production of chemical fertilizers by opening a new ammonium sulphate factory at Sindhari (Bihar). The Indian soils are deficient in nitrogen and cheap and easy availability of ammonium sulphate will make a long stride in raising the fertility of the soil. But it must be realized that application of chemical fertilizers alone to the soil without an appropriate dose of organic manure will in the long run cause harm to the texture of the soil.

Farm yard manure and compost, therefore, will not only continue to enjoy their importance in the improvement of the fertility of the land but will have enhanced utility with the increased production of chemical fertilizers and their use. The propaganda done so far to preserve the entire cattle dung for use as manure did not have the desired effect because of acute fuel shortage caused by deforestation, far exceeding afforestation and reduction of area under orchards, resulting in considerable portion of the cattle dung being utilized as fuel. Further shortage of organic manure has resulted on account of town wastes and manure heaps being used in brick kilns in the absence of coal. In order to bring about improvement in preservation of greater quantity of organic manure, it is therefore, necessary to effect afforestation at a rapid pace, grow *Babul* (Acacia) trees on the borders of the fields and keep them pruned to avoid shading of crop plants and plant such trees and the like in ravine areas. It has been observed that *Babul* trees allowed to grow in this way do not very much affect the yield of crops. These trees can grow without much care. In areas subject to depredation of wild animals and stray cattle prosopis trees can be grown within a few years. On low lands which remain under water in the rainy season, Meunri and other trees capable of resisting water may be planted. With such measures adopted to increase the fuel supply it is probable, nay definite, that very much greater quantity of cattle dung will be preserved and utilized as manure than at present. The next step is to improve the quality and quantity of farm yard manure by preserving cattle refuse on scientific lines in pits made on raised ground. Cattle urine may either be collected in pucca pits and applied particularly to kitchen gardens directly in liquid form diluted with irrigation water, or allowed to soak in Bichali and transferred to the manure pit. Household refuse obtained from sweepings, weeds and leaves dropped from trees can be composted and used as manure. Human excreta, a very valuable manure, does not only go waste but, in utter disregard of sanitation, is dropped all over indiscrimi-

nately around the dwellings and breeds flies and spreads disease. Villagers may be induced to open out furrows in their fields for use as latrines and cover them after use. If screens made of stems of Jwar, Bajra or Arhar, etc. are fixed along the furrows, people will be attracted all the more to use them. If one person in the village having progressive ideas takes the lead, others will follow suit.

Another way to improve the texture and the fertility of the soil is to plough in plants of *sanai* (SUNN hemp) and the like before the flowering stage at least a month or so before the finish of the monsoon so that these plants may fully rot. The Government have already taken steps to encourage this practice by giving certain concessions to the cultivators which should be made known to them by the Development staff to let them avail of these concessions.

EARTHEN DAMS FOR STORAGE RESERVOIRS

By

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Site :—This should be carefully selected in regard to the gathering ground, the nature of the surrounding and the underlying soil, the requirement for irrigation and live stock, as well as the cost of construction. The most favourable site as affecting cost, is where a small embankment, thrown across a valley or a *nalla* will form a large reservoir. It also depends on the longitudinal section of the site of the embankment. The cost of a dam varies roughly as the square of its height. Dams which are long but low are generally cheaper and safer than shorter and higher ones.

Foundation :—The most important points to be considered for the foundation of an earthen dam are that the soil should be cohesive which may not give way when softened and that it will not slip or settle under the pressure of the embankment.

The best foundations for a dam are as follows :—

(1) Hard compact rock. The surface should be even or sloping slightly downward from the down stream side towards the upstream side of the dam.

(2) The softer rocks.

(3) Hard, compact, and solid gravelly soil.

(4) Hard clay soil.

(5) Brown and Red soils, and lastly

(6) Black cotton soil.

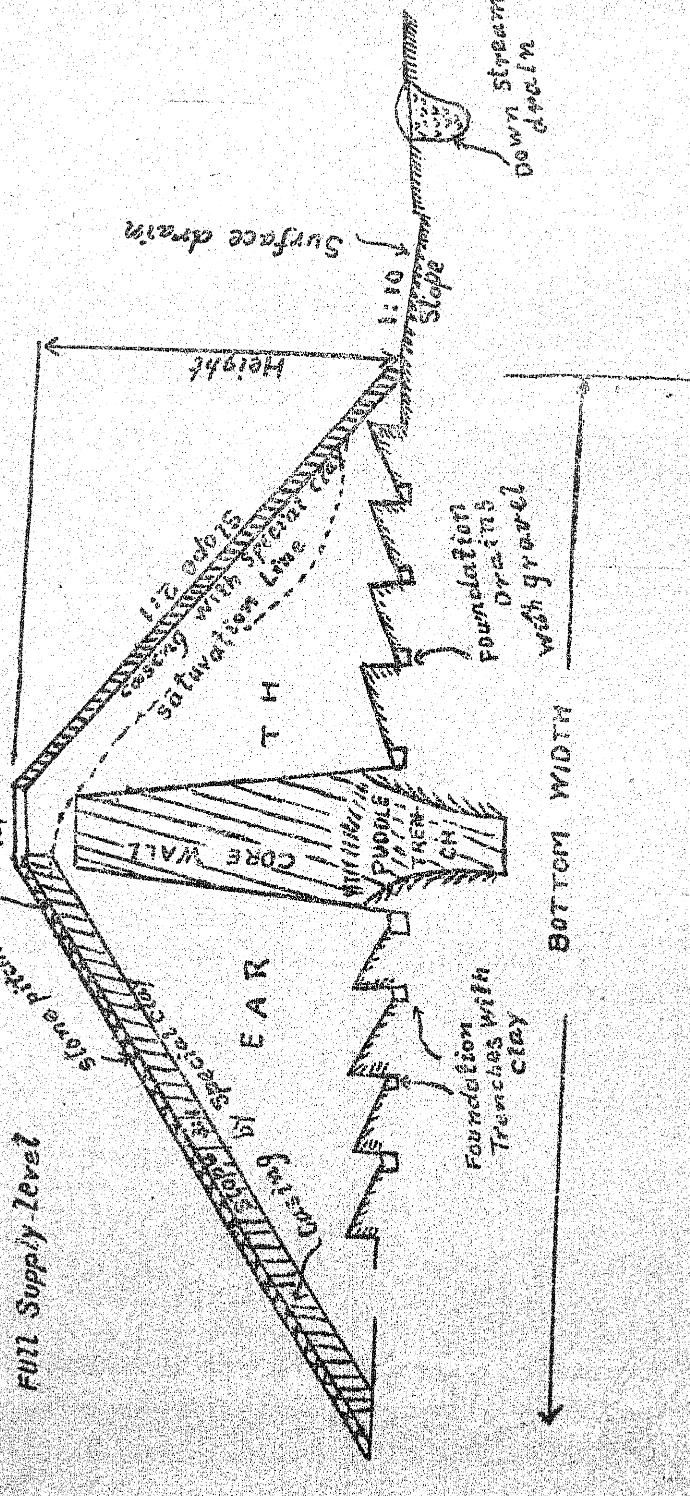
All soils which are light and lacking cohesive property and those which become slippery under the action of water are undesirable for the foundation of a dam.

Drainage of the dam foundation :—It is most important to drain the ground itself at the rear of the down stream. It is also advisable not to allow the rear part of the dam getting wet otherwise the embankment may be badly damaged

or even may break away. To attain this object it is slope of the ground just below the outer toe of the dam for a width of 10′-30′ according to the size of the embankment at 10% slope and at the end of this slope furrow a suitable sized surface drain. This slope and the drainage channel will remove all this rain water immediatly coming down the slope of the dam and giving the least opportunity for the rain water to soak in and wet the embankment. The foundation drains, if provided, give life to the dams.

The maximum amount of percolation through an embankment will probably occur along the base of the dam at its junction with its foundation. It is, therefore, desirable to take precautions to firstly prevent this percolation and secondly to drain away whatever percolates. On the up stream side of the foundation of the dam a group of small puddled trenches, parallel to the main central one, and on the down stream side a similar series of trenches, or "foundation drains", should be provided as shown in the sketch. The up stream trenches are filled with retentive material and those on the down-stream side with porous materials.

Core walls :—The object of providing core walls is to prevent entirely any filteration which may have penetrated so far. There are two types of core walls :—(1) PUDDLE CORE WALL, (2) MASONRY CORE WALL. (1) There is a general practice of having a *puddle wall* along the centre line of the dam. It is placed vertically over, and made one with the puddle trench so as to form with it a water-tight septum, extending throughout the dam from below bed rock level to above high flood level. (2) The American Engineers are greatly in favour of masonry core wall for earthen dams. Probably masonry core wall is superior to puddle wall but it is more expensive.



CROSS-SECTION OF A DAM

Section of the dam:—The section of embankment depends upon :—

(*a*) The angle of repose of the soil when dry and when saturated.

(*b*) The nature of the foundation.

(*c*) The height of the embankment.

The following table shows the general section for ordinarily good soils properly consolidated :—

Height of dam above ground level.	Top of dam above H. F. L.	Top width	Up-stream slope.	Down-stream slope.	Width of dam at H. F. L.
	Feet.	Feet.			
15 ft. and under ..	4 to 5	6	2 to 1	$1\frac{1}{2}$ to 1	20 to $23\frac{1}{2}$
15 ft. to 25 ft. ..	5 to 6	6	2·5 to 1	2 to 1	$28\frac{1}{2}$ to 33
25 ft. to 50 ft. ..	6	8	3 to 1	2 to 1	38
50 ft. to 75 ft. ..	6 to 7	0	3 to 1	2 to 1	40 to 45

Side slopes of dam:—The lower the dam the steeper the side slopes may be. The side slopes primarily depend on the nature of the soil. The side slopes given in the above table have been found in practice, by numerable examples of different kinds of earth-work, to be satisfactory. The upstream slope is made flatter than the down stream one, as it usually consists of material of a more clayey nature and it is saturated by the water of the reservoir.

Settlement of the earthwork :—No matter how well a dam has been consolidated during construction, there will be subsequent settlement. The vertical settlement of a well constructed dam should vary from 1/30th to 1/36th of its total height, and should be allowed for when setting out the work.

Pitching :—In a large reservoir the action of the wind will cause waves, which if allowed to break on the unprotected embankment, will very soon wash away the earth-work. The object of the pitching is to protect that surface. It is usually laid on a six inch layer of gravel or quary spauls so as to prevent the entry of vermin and the growth of plants, and to prevent the under mining of the pitching by wave wash.

It is desirable to start pitching after full consolidation and settlement. The stones of pitching should be laid with their broadest ends on the slope of the dam. Where roughly

squared stones are available at cheaper rates they can be laid properly and they will make the best kind of dry stone pitching.

Storage capacity :—The calculation of the storage contents of a reservoir is made by summing up the contents between each of its contours.

The formula used for calculating the volume of storage between two contours is :—

$$Q=\frac{H}{3}(A+a+\sqrt{A\times a})$$

where Q = Capacity in cubic ft.

A = the area of a contour in square feet.

a = Area of the adjacent contour in sq. ft.

H = Vertical distance between the contours in feet.

Earthen dams when their height exceeds 15′ or 20′ must be designed and constructed with due precautions and skill if the work is to be of permanent nature.

Extent of saturation in embankments :—The clay material parts slowly with the water it has absorbed, the level of the water in saturated clay of an embankment falling much more ilowly than the water in the reservoir. The trend of saturaton has been shown in the diagram.

References :—(1) Indian Storage Reservoirs with Earthen Dams—W. L. Strange.

(2) Irrigation and Water Supply—John Scott.

(3) Pocket Book of Irrigation Engineering—Buckley.

THE FARMER DEALS WITH LIFE

By

O. E. Baker

Deeper the differences between individualistic or laissez-faire economics and socialism, deeper even than the differences between capitalism and communism, are those between rural and urban attitudes toward life.

The farmer tends to think in terms of plants and animals, of birth and growth and death. The city man tends to think in terms of wheels and levers and machines, or of buying and selling.

Agriculture is founded on life processes, particularly as influenced by soil and weather and the laws of inheritence; urban occupations are founded on manufacturing and commerce, and the activities are mostly carried on indoors.

To the city child milk is associated with a bottle, not a cow; an apple comes from a box, not from a tree; and these early impressions influence the ideas of later life.

The farmer's philosophy of life is primarily organic; the city man's philosophy usually is mechanistic. The farmer lives in a natural world, the city man in an artificial world.

Because of his occupation the farmer's thoughts are largely biological, whereas the city man's thoughts are largely physical or economic. In farming the family is the economic and social unit—it is difficult, almost impossible, to farm without a wife, and children can help with the work from about ten years of age onward.

In the city the individual is the econmic unit—a wife adds little, if anything, to the family income unless she works outside the home, in which case it is difficult to rear a family, and children involve expense, with little if any return, from birth till marriage. It costs generally two to three times as much to rear a child in the city as it does on the farm.

Perhaps because of the open air, and the contact with nature, perhaps because the farmer sees the stars at night and observes the progress of the season, perhaps also because of stronger family ties, farmers and farm women tend to think of the past and the future; city people tend to think more about the present.

Ruskin wrote many years ago "There is no wealth but life." The farmer deals with life—plant life, animal life, and human life. Crops are planted and harvested year after year. Individual plants die and disappear, but the production of wheat and corn and cotton goes on without end.

Agriculture is based on this fact of reproduction, and the continuity of life. The farmer is the heir of all the ages, with an opportunity, through animal breeding particularly, to benefit all the ages to come.

The oldest thing in the world is life—older than the mountains, older even than the rivers. And the youngest thing in the world is life.

THANKS FOR RAIN

Thank God for the rain !
The earth was cracked and dry.
Our crops were burning up—
The rice and wheat—both mainstays of our lives.
The wells were dry. At night
Small groups stood around them,
Drawing in scant cupfuls
The last few drops.
The air was hot and stifling,
And listlessly we moved
About the necessary tasks of life.
Then—miracle—out of a hot dull sky
Great thunderclouds arose.
One muttering roar before the rain was on us.
A breath of freshness,
Then a roll of silver feet
Across the arid fields and dusty trees.
The birds, in sudden wakening
All chirped and sang with feathers fluffed and spread.
The earth took on a deep brown hue
Of richness ready to be thrown abroad.
All green things laughed in new sweet life,
And we, with glowing hearts,
Raised grateful hands to Heaven with—
Thank God for the rain !

—MARGRET STEWARD.

EDUCATION FOR LIFE

The basic problem of our age is one of education, not the education of supermen to deliver the ideal state through the aristocracy of a ruling class, but the education of the common people and the leadership which is indigenous to the common people. One of the tragedies of our day is the way in which the elaborate school system which is available to so many people stresses scholarship, fosters competition, and stimulates the leadership which emerges to seek wealth and power as ends in themselves. What is needed is a school which will take these people, give them the techniques and inspiration which only a school can give, and send them back as the leaders and servants of common people of whom they are a part.

This, precisely, is what the Danish Folk High School or People's School undertook to do nearly a century ago in rural Denmark. The People's School grew out of the teachings of the great Danish prophet, Grundtvig, a scholar, a poet, and a theologian whose philosophy of education still dominates the people's school movement in Denmark and elsewhere, and whose ideals for his people have become a part of the philosophy of life by which the Danish people live.

One of the faults which Grundtvig saw in the free society was that the people, apparently content with political freedom, were not sufficiently resolute to create free schools and a free culture. He found that the prevailing educational system served the interest of scholars only. "We are immeasurably rich in ideas, but great beggars in reality; rich in knowledge, but poor in vital force."

SCHOLARSHIP OR EDUCATION

In the period of young adulthood, from 18 to 25 years, Grundtvig recognized that there was in most people a moment of "spiritual creation" which is the richest opportunity which any educator could want. There is the moment when the slumber of youth and adolescence is over and the young adult embarks upon maturity. The primary aim of education in this period should not be scholarship. "Scholarship is one thing," wrote Grundtvig, "and education and fitness for life is another, they may well be united, but not in the case of majority; they must not be hostile to each other; they must be kept separate, otherwise they seek to drive each other out and necessarily spoil each other. Scholarship will lead scholars astray if it is not confronted by an education of the people

which obliges it to take present-day life into consideration, just as the education of the people will soon degenerate into a superficial polish if scholarship does not keep it alive." Schools for scholars have been amply provided, then as now. Grundtvig evolved his plan that there must also be schools which are primarily concerned with the spirit and emotions if any "vital force" is to be imparted to the people at large. Given the great urge to take the implements of a free society into their hands, they are then prepared to live and to learn the vocations and the techniques with which they will find their useful places in society.

Out of the writings of Grundtvig two doctrines emerge which may leave their stamp upon the free schools of the world for some time to come. The first of these is his concept of the functions of the school for life. On the one hand it must aid the individual to unfold his own potentialities to the full, "to awaken, nourish and enlighten human life. 'Know thy self' is the right inscription above all school doors." Then the school for life must fit him for active and constructive membership in the civic community. How is the school to do this?

THE STREAM OF LIFE

What shall be the sources of its power to give life a vital force? Grundtvig gave three media: history, native language and song. History taught as the inspiring and creative experience of men and not as dates and events, was in every thing, as all teaching was related to the stream of life of which the student was to be made a part. Native language—the student must speak and write it, thus the leadership of the people of Denmark was made articulate. And song—every lecture started with a song—not sentimental jingles but songs of great meaning for the young people of Denmark. The Danish hymnal of today is filled with hymns from Grundtvig's pen.

THE LIVING WORD

The second of the doctrines of Grundtvig which have had great influence on the people's schools is the doctrine of "the living word." He taught that only the spoken word can convey life from one person to another. The written word, to the great majority of people is ineffective in this work of giving life. Once the bond is established the written word may buttress or extend conviction, but the first impulse of life must be the spoken word.

SPIRIT OF FREEDOM

Out of these doctrines a three fold statement of principles has been distilled from the writings of Grundtvig which has much of the flavour of bilical passages : "The Spirit is power"; "The Spirit speaks through the living word"; "The Spirit speaks only in freedom." Simple as these precepts are, out of them have grown People's Schools which have given a better life to the common man. Now there are sixty such schools in Denmark and one fourth of the young people of the country attend their short three to five month courses.

CHARACTER OF THE PEOPLE'S SCHOOL

Briefly the method and aims of the People's Shools may be summarized as follows :

1. The emphasis of instruction is upon the awakening of the spirit, rather than upon the aquiring of knowledge or skill.

2. The method of instruction stresses the "living word"; lectures and discussions in which there is life are the principal programme.

3. The historical approach characterizes all construction, even the sciences, and history is a living subject.

4. The subject matter is confined largely to those subjects which are useful to the average man in his personal or civic life.

5. There are no grades, credits, degrees, or examinations. The primary emphasis is upon instruction and not on competition between students.

6. The fact of a group of students living together is utilized as a fundamental educational medium. The teachers utilize this opportunity by living with the students and using their influence to create a co-operative community.

7. The schools are dominated by a high etical purpose. They seek to give the student the opportunity to know himself and to supply him with the motivation to exert a constructive influence in all relationships of life.

8. The schools furnish an incentive to leadership which is loyal to the people's cause. No effort is made to attract people who aspire to scholarship or wealth or power for their selfish advancement or enjoyment.

THE RESULT—A MORE ABUNDANT LIFE

The Denmark towards which the efforts of Grundtvig and his followers were directed was a land of despair. The depredation of war and the loss of part of the country to Germany had left the land poor in material wealth and depressed in spirit. A change in agricultural markets during the nineteenth century had cut away the established agricultural export business and had left the farmers in a condition which seemed hopeless. It was in this setting that the People's Schools undertook to bring a better life to the farming community of Denmark.

How have these schools influenced the national economy and culture? In a brief statement it is difficult to make any careful appraisals of their effect. While the People's Schools did not teach any political or social formula and made no concerted propaganda for any particular cause, they gave the great incentive form which many social movements sprang. Without any direct urging of a particular line of action the effect of the People's Schools was principally to awaken the young people and to give them the techniques of leadership embodied in native language, history and the social sciences. No description of subject matter would convey the fact that there is life and purpose and a will to better the lot of the common man in these schools. What the school did was to prepare the soil, in which the great people's movements could thrive. The Danish farmers, given the People's School preparation, have made their democracy effective by extensive organization for political action, for consumers' cooperation, and for farm marketing cooperation.

(Condensed with permission from *Consumers' Co-operation*, September, 1936.)

Prayers of African Women As They Hoe Their Fields

Father be with me now as I begin to hoe.
You have planned that by working and perspiring people receive their food.
Be with me today as I work together with You.
Hear me, I pray in Thy name,

Amen.

Our God to Thee we give thanks.
We didn't believe we would see light again.
In your love and in your sunlight we will receive many things.
Be near me as I begin to hoe.

Amen.

Dear Lord God,
Now that I am going to work with my hoe.
Turn away from my garden all prowling evil.
Also give me strength to do my work well.

Amen.

The above prayers have been translated from the vernacular by Mrs. Ruth Engwall, Union Training School, Kimpese, Congo Belge. Reprinted from the Congo News Letter, published by the Missionaries of the American Baptist Foreign Mission Society.

Published by :—The Allahabad Agricultural Institute, Allahabad, U.P. (India)

THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL

OF

AGRICULTURE AND RURAL LIFE

CONTENTS

Vol. XXII JULY, 1948 No. 4

The Rains Have Come

The rains have come !

For days and weeks and months.

The earth, dry, parched,

Has opened her mouth toward a brazen sky.

The sun, a fiery orb,

Has mercilessly run his daily course,

Giving no heed to the panting earth,

But at long last, in blessing,

Soft raindrops, one by one,

The parched earth caress ;

And throbbing, sobbing,

The glad, good earth receives,

And bursts forth in a grateful song of praise.

The rains have come!

Emma K. Ziegler

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Agricultural Institute,
ALLAHABAD, U. P.

THE ALLAHABAD FARMER

BI-MONTHLY JOURNAL OF AGRICULTURE AND RURAL LIFE

The ALLAHABAD FARMER is now approved by the Directors of Public Instruction in the United Provinces, Bengal, Central Provinces, Sind, Assam, Bihar and Orissa, the Rural Reconstruction Commissioner, Punjab, and by the Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to Rajputana and Central India States, for use in all schools under their jurisdiction.

Subscription Rates

Annual subscription: India, Rs. 3; England, 4 shillings; U. S. A, 1 dollar. Single copies 10 annas; over five years old, 12 annas. Copies which are not received by subscribers will be supplied free of cost within six months of the month of issue. Thereafter single copy price will be charged.

Unused portions of subscriptions cannot be refunded

Advertising Rates

	Rs.	a.	p.
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Page 4 of cover for six numbers	70	0	0

Contributions

The ALLAHABAD FARMER is published in the first week of each alternate month commencing with the month of January. Contributors are requested to send in their articles at least one month prior to the next prospective date of publication.

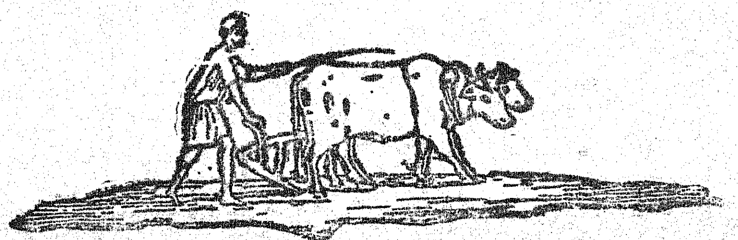
Contributors will receive 15 reprints of the article published and, additional copies at cost.

Publisher—The Allahabad Agricultural Institute, Allahabad, U. P.(American Presbyterian Mission).

Printer—The Mission Press, Allahabad, U. P.

THE

ALLAHABAD FARMER



Vol. XXII] JULY, 1948 [No. 4

Editorial

The continuing food shortage.

Some months ago, it appeared that the food situation in India was easing a bit. The improvement in the supply, plus the increasing difficulty in administering the rationing system effectively, led the Government to discontinue rationing throughout India and to withdraw most of the controls over food distribution.

That the earlier promise of improved conditions has not materialised is evidenced by various things. Prices for food continue to rise; even in the rainy season when vegetables are in season, hardly any vegetable is available in the markets of Allahabad for less than eight annas per seer; potatoes are a rupee; ordinary qualities of rice are about one rupee per seer and wheat ata is about one and one-half seers for a rupee. That the Government is concerned about the situation is evidenced by the announcement that partial rationing for low paid workers would be brought into effect in selected areas and the later announcement that it is proposed to revert to controls substantially on the same basis as was previously practiced indicates a mounting concern.

Why has the situation deteriorated? Basically, it is because India has increased her populatation beyond the capacity of her food resources. To be at all safe, a country should have in hand at the end of any major harvest season, enough food not only to carry it through the next agricultural year past the next harvest season but a reserve of anything from

50% to 100% of a year's supply. In other words, at the end of the rabi harvest in 1948, there should have been enough food grain to last till December 1949. Instead of this, if there is a major failure of the kharif crop in any section in 1948, there seems likely to be acute distress.

That there is likely to be such a shortage seems likely. After a normal beginning of the monsoon, there has been continuous and heavy rain over a large part of North India, enough to seriously damage crops and there is a threat of widespread floods which will further damage crops. Already it is said that the Maize crop is a failure and that rice even is seriously affected.

The earlier hope that 1948 would see a large scale resumption of rice import from Burma seems likely to end in disappointment. Widespread political unrest is not only interfering with shipments of rice but is likely to seriously reduce production so that even if there is a return of stability politically, there is little likelihood of large supplies being available. The short haul from Burma to India made supplies from Burm particularly attractive. Even if supplies from elsewhere are available, there is question whether shipping will be available to move the requisite amounts the greater distances.

While the general aim of Government policy has been to increase food production in the country, the question naturally arises as to whether the policy has been aggressive enough, whether it has been along right lines or not and whether there is reason to hope that the programme of increasing production can keep up with the increasing need.

A few quotations from an article by Prof. F. J. Stare, Head of the Department of Mutrition at Harvard University and Editor of "Nutrition Review" may give food for thought. Prof. Stare says in part:

"The main purpose of food is nutrition. The shortage of food is primarily a shortage of calories. What has our Government done to tell the individual—the farmer, the distributor, restuarant owner, housewife—how to achieve the maximum nutrition from the resources at our command?"...

"Man and animals compete for nature's food. Basically, energy from food comes from the sun through the process of photosynthesis in plants. Hence the amount of food energy available depends on the amount of soil cultivated and its productivity. The following table of the amounts of

fertile land required to produce one million calories from each of various foods shows the relative efficiency of production of human food calories :—

Food source.	Acres of land.
Sugar	0·15
Potatoes	0·44
Corn—as corn meal (maize)	0·9
Wheat—as whole wheat flour	0·9
Wheat—as refined flour	1·2
Hogs (pork and lard)	2·0
Whole milk	2·8
Eggs	7·0
Chickens	9·3
Steers (beef)	17·0"

While a table might be complied which would apply more directly to Indian conditions, the above table will serve to show that there is an enormous difference in the amount of food energy produced from different sources. It is of course true that food requirements cannot be met by calories alone. Neither can they be met by so-called "protective foods" without calories.

The situation would seem to suggest that, in addition to measures now being taken, such as bringing additional land under cultivation and the grow more food campaign, still more drastic steps will have to be taken. Some such steps as the following may become necessary in the comparatively near future :

(*a*) Limitation of the number of animals kept to those which can be maintained essentially on by-products not suitable for human food.

(*b*) Restriction of the area which may be devoted to crops other than food and essential fibres or crops which can be exchanged in the world market for these commodities.

(*c*) Possibly control of the *proportion* of different kinds of food crops which may be grown, particularly if rationing prevents free adjustment of area due to price variations.

(*d*) Large scale control of wild animals and rodents which destroy crops.

The continuing food shortage would seem to raise questions as to whether all the above taken together in the most vigorous way possible could be expected to meet the difficulty if the population continues to increase as in the past and at present.

IMPROVED LOW COST CHULA

By

Rajendra N. Pahalwan,

Agricultural Engineering Department, Allahabad Agricultural Institute.

People have felt the need of an improved chula so that the facilities of the house wife may be improved and needs may be met. Most of the cooking in the city and villages is done on small open fires ; wood, coke, charcoal and dung cakes being the fuel. The fire is built in small and fire places and the utensils are kept directly on the fire.

Generally one fire is used to heat one vessel only and rarely two or three at a time. The vessel is kept directly on the fire and it would seem to be conducive to high fuel efficiency but this is not always true. Often the flames run over the vessel and are wasted. Only one vessel is heated at a time it prolongs the time the fire is burning and lengthens the time spent in the kitchen. The fire needs constant attention. On such open fire only frying and boiling can be done.

The worst of all the objections to this open fire place is that of being dirty. The heated air, carbon-dioxide, ashes and the smoke are usually allowed to discharge into the room. Much of this settles back in the room. The smoke, ashes, etc., are deposited on the walls and the roof and make the room dirty and discourages cleanliness.

The Agricultural Engineering Department of the Allahabad Agricultural Institute has developed an improved built-in-cook stove and practically all the quarters in the institute have been equipped with it. It has been found very satisfactory to all who have used it but the only disadvantage is that it is costly to built because steel rods, steel oven, cast iron, hot cover plate and cement are used in its construction.

For those who cannot afford to have this type of built-in-cook stove the Agricultural Engineering Department has recently developed an improved low-cost chula which every one including the poorest can afford. This has been developed keeping in mind the need and cost for even the poor family.

An ordinary mason or one who has been building mud open-flame chula can built it. It can be made of such materials which are easily available every where. It is simple to construct and to use. One using the ordinary open flame chula can use it.

21″

In spite of its being very cheap it has all the features which an improved chula (stove) should have.

1. It is economical of fuel.

2. It enables one to cook more than one thing at a time with one fire. Baking is also possible.

3. The fire is enclosed and the smoke, hot gases, etc., are carried out of the kitchen through a chimney.

4. The fire can be controlled easily.

5. It is primarily designed for wood but can be adapted for coke, charcoal, etc., by fixing a grate in the fire box.

6. With no extra cost hot water can be had.

As the smoke is allowed to pass through a chimney and discharged outside, the kitchen walls and roof are not spoilt by the smoke. The eyes, nose and the lungs of the user are not affected. The house wife is not required to blow constantly to keep the fire burning as the natural draft keeps it burning. Thus the ashes too are not thrown up and do not settle on the food and the utensils as is caused when the fire is blown in the usual way in the open flame fire place.

This chula can be cleaned by applying 'Lal Mitti,' 'Pili Mitti,' etc., as the materials used in its construction and the ways and the means of its cleaning are the same as those which are employed at present, hence orthodox people can also use it without objection.

This improved low-cost chula can be built with any of those materials which are at present used for constructing open-flame fire places, chula. It can easily be made of mud mixed with bhusa and dung, sun-dried bricks, or burnt bricks laid in mud mortar. Bricks laid in mud mortar will make the work easier and the finished job will be neat and clean.

It can be fixed any where in the room or the varandah but a corner is preferred because of the case in setting the chimney. Above the fire-box where the fire is built is a hole for the vessel to be heated. The flame, smoke, hot gases, etc., are not allowed to come out into the room from any one of the two holes for the vessels, A and B, but are forced to pass through a passage passing around the handia (to be used for baking, cooking or keeping stuff hot) and the matka for the hot water, and are finally discharged into the chimney. If only one opening is being used to heat, the other hole should

be kept closed with a pot containing water, or a *tawa*, or an earthen dish. The handia is not meant for baking only but can be used for keeping food hot. It can also be used for cooking food. After dal or vegetable is cooked for some time, it not longer requires open flame and constant attention, but may be transfered to this handia for completion of cooking and the fire may be used for cooking other things. In this way the house wife can reduce the time spent in the kitchen.

The holes A and B on which the vessels are kept should be smooth and round and the size should be such that the vessels may cover it and not allow the smoke and the gases to come out, and only the bottom of the vessel should be exposed to the flames. To get a good finished job so that the vessel sits snugly over the opening, the neck of the broken handia may be built into the chula.

The chimney is made either of mud, country tiles (Nalya), metal, or bricks. Chimney made with any of these materials will serve the purpose. The top of the chimney is allowed to come out of the roof into the opening atmosphere. The top of the chimney which comes out over the roof should be made pakka or for that part of the chimney metal should be used.

The chimney is fitted with a damper which is placed in the chimney at such a height so that the operator may use it without difficult while remaining at the place where cooking. It should be at any easy reach. The damper is a flat piece of metal of the same size as the cross-section of the chimney. It has a wooden handle with which it could be worked either to open or to close the chimney passage to increase or decrease the draft. This chula will not work well without the damper because the fire cannot be controlled, therefore, the damper is recommended, and very soon the user will realise the value of the damper.

The care which should be given while constructing the chula is that the maximum area of both the handia and the matka should be exposed to the hot gases. This will ensure maximum amount of heat from the hot gases. This will ensure maximum amount of heat from the hot gases and the smoke and thus the maximum amount of heat given out by the fuel is utilised. Only the neck of both the handia and the matka should be exposed and the rest of it should be placed in the passage taken by the smoke, hot gases, etc., in such a way that maximum area may be heated.

One such improved low cost chula was built and worked with full success at the Allahabad Agricultural Institute during Farmers Fair, March 1948, when a lot of villagers saw it working.

Dimensions and other details are given in the sketch. Anyone who has any question regarding this low cost improved chula or has any difficulty may write to the author or the Agricultural Engineering, Allahabad Agricultural Institute, Allahabad, and we shall be glad to help solve the difficulties.

NOTE:—The 'Handia' and the 'Matka' are the two earthen vessels used in Indian homes. The 'Handia' has a larger opening and is smaller in size than the 'Matka' which has a smaller opening and is larger in size.

RAISING DAIRY CALVES ON A MINIMUM OF MILK

By

T. W. Millen, M.Sc., D. V. M.,

Head of the Department of Animal Husbandry and Dairying, Agricultural Institute, Allahabad.

The present milk shortage in India threatens to be a permanent situation if we cannot by some method increase supply faster than the regularly increasing demand. There are several ways of alleviating the situation and a number of large schemes for cooperative marketing of milk, Government breeding farms and model dairies are under way. We are interested in what the average cow owner can do to help out.

Stock improvement.

It has been recognized in the leading dairy countries of the world that to maintain a high-yielding herd the heifers must be sired by the best bulls obtainable and the calves raised under the best environment possible. The famous herds are often built around one good cow along with her daughters and grand-daughters. In any case the best dairymen keep all their heifer calves so that they can replace the poorest producers with higher-yielding home-raised heifers. In Europe and America the average dairy cow has a lifetime average of between four and five lactations. The situation may be somewhat better in some parts of India but in areas where rinderpest and haemorrhagic septicaemia are prevalent the average may be still less. Since in a given cattle population at least half the calves born each year will be males, it will be necessary to raise half the female calves born for replacements and many of the others if any selection is to be practised.

Wasting our dairy animals.

A pernicious practice in India is the purchasing of the best cows obtainable from the breeding areas, milking them till they are nearly dry and then disposing of the cow and calf in a way that they are too often lost to future production. Many of the city cattle keepers are anxious for the most milk possible and often cheat the calf beyond its ability to survive. In many such cases the cow will not yield any milk after the calf is gone. With the usual practice of underfeeding the calf, the productivity of the heifer is greatly limited before she matures and the owner knows she will

seldom sell for more than one-fourth of his expenditure on her when he no longer needs her for priming the cow at milking time.

Post-natal care of the calf.

In this article we take for granted that the heifer calves in question are from good parents and are worth raising. We recommend that they be weaned from their mothers at birth. The cow should not be allowed to see or lick the calf and it should not be allowed to nurse from her even once. If the calf receives as much as one mouthful of milk with its nose up, it is very difficult to train it to drink from a pan or pail. If the cow and calf never see each other they fail to miss each other, should either suddenly die or be sold. Immediately after birth the navel cord should be shortened to about one inch by cutting it with a pair of sterilized shears and the stub painted with tincture of iodine. The calf is dried with a towel or clean gunny bag and removed to a clean place preferably with a brick or cement floor.

The calf's first meal should be the colostrum from the mother. If a finger of the right hand is dipped in the colostrum and the calf's head lowered into the pan with this finger in its mouth, she will usually begin drinking very quickly. The milk should always be at blood heat and should be fed in a clean container. The calf should be fed according to its size and breed. Six to eight pounds of milk a day to a Red Sindhi or Sahiwal calf would be about right. After a few weeks the calf may be given skim-milk for part of the whole milk and after six months the milk may be stopped provided a balanced concentrate ration is fed along with adequate roughage.

Milk necessary to property feed a calf.

Our custom at the Agricultural Institute was to feed about 300 lb. of whole milk and 1,200 to 1,500 lb. of skim-milk to each heifer calf during the first six months of her life. As production costs mounted with the rising prices of concentrates, fodder and labour, it soon became very expensive to feed the calves. Also we had a ready market for all the milk produced at a rate double the prevailing in 1940. We began to look for a satisfactory substitute.

Milk substitutes.

In Western countries powdered skim milk is often a cheap source of milk substitute but in India this product finds its way into human food. Fish meal has also been used in the

West but in India very little fish meal of feeding quality has been produced. Whey and butter-milk also are not readily available.

We had started making blood meal for swine and poultry feeding in 1943. In looking up references on blood meal feeding we came across the 'New Jersey dry-fed calf mixture.' This seemed to be what we were looking for. This mixture is as follows :

Yellow maize meal	25·0 lb.
Ground oats	37·5 "
Wheat bran	12·5 "
Linseed meal	11·5 "
Blood meal	12.5 "
Steamed bone meal	1 "
Pulverized limestone	1 "
Salt	1 "

In the New Jersey system about 150 lb. of whole milk in all is fed to the calf. It is started out on 6 lb. of milk per day but after three weeks the milk is gradually reduced and water substituted until the calf receives only water to drink after it is 30 days old. At this time it should be eating about one pound of the meal per day along with good quality lucerne or clover hay. The calf has been receiving all the dry concentrate mixture and hay it would eat from the time it was one week old. Fresh water is available at all times. After six months the calf is fed a ration containing no blood meal.

We have tried the method using the prescribed ration and have found it suitable for Indian conditions. We have, however, modified it a bit to suit our requirements. *Juar*, gram or *birra* may be substituted for the maize. Barley can be substituted for the oats and *chuni* of one of the *dals* or peas for the wheat bran. There is no substitute for the blood meal as the young calf requires certain amino acids in its youth that are found only in animal proteins.

Vitamin-A feeding essential.

As vitamin-A rich lucerne or clover hay is not available readily in India, we see that the calves are fed a mixture of chopped green feed and dry grass daily. If this is not done many deaths will occur and the calves will not grow properly. Our problem was to have something green every day of the year. We use berseem, lucerne, sweet potato leaves, serpentine radish plants, *papita* leaves, *doob* grass, napier, *bajra*, green *jowar* and cowpea according to the season. If the

calves are fed green fodder only, they are liable to scour. If only dry hay is given, they are liable to constipation as well as vitamin-A deficiency.

With this method of feeding it is noted that the calves lose condition after they no longer receive milk but by the time they are three to four months old they are in as fine condition and have grown as well as animals fed on the more expensive milk ration.

When we replace the whole milk with skim milk gradually instead of using water, we find that the calves escape this second month slump. With this system we feed the skim milk for the second month only so that the calf receives 150 lb. of whole milk and about 210 lb. of skim milk. We have saved 150 lb. of whole milk and over 1,000 lb. of skim milk by this system compared to our former method of feeding calves. Besides having this added milk for human consumption we have saved about Rs. 120 in feeding each calf.

Precautions

The meal mixture should not be allowed to become moist as it quickly ferments and becomes unsuitable for feeding to the calves. The calf should not be allowed to eat more than 6 lb. of feed per day but up to this amount it should be given all it will eat. Green feed must be given daily as the calf has no vitamin-A reserve. Fresh, clean water should be before the calf at all times.

Economics of using milk substitutes.

Last year we fed 7,370 lb. of dry blood meal to our calves, saving over 16,000 lb. of whole milk and 1,10,000 lb. of separated milk. Actually about 1,25,000 lb. of milk was available for sale as fresh milk or for making into dairy products for human consumption as we usually separate just enough milk for feeding the calves. We saved over Rs. 10,000 in feeding the calves up to six months of age, by using the milk substitute. Each pound of dried blood spared about 17 lb. of milk. It would take the full production of 42 cows averaging about 3,000 lb. per year to provide the milk that we replaced with dried blood.

In a city of 2,50,000 people enough blood is wasted in the slaughter houses each year to replace 2,50,000 lb. of milk.

This waste blood can be made into edible blood meal by a Government servant or private party and sold to those wishing to raise calves or the calf owner himself could make up a year's supply in a few days.

Complete instructions for making the blood meal are found in the article published earlier by the author.[1] If the blood now wasted is made into calf food, India will have more thrifty cows and more milk for her hungry millions. Non-producing cows should be made to yield their blood and bones for the next generation and their meat for protein-starved humanity.

1 *Indian Farming*, May 1946

THE MANUFACTURE OF AGRICULTURAL IMPLEMENTS IN INDIA

By

R. P. Saxena, B. Sc.,

Agri. Engr.; Junior A. S. A. E.; A. I. B. A. E.

The population of Indian union is probably now in the neighbourhood of 350 million of whom nearly 300 million depend on agriculture for their livelihood, as agriculture is the key industry; for on the produce of agriculture other industries depend for their raw material as well as for the health, efficiency and contentment of their workers; on the price of agricultural production depends the cost of production of other industries and in the rising prosperity of India's other industry will certainly find scope for the expansion of internal market greater than they might find any where else in the world. The tendency of all civilized nations today is for each to make itself a self-sufficient economically as circumstances permit. No country which aspires to be reasonably self-supporting can do without agriculture. At the same time, no nation has grown rich through agriculture alone. With the growth of civilization and multiplication of human wants, the occupation associated with industries and manufactures has increased in importance and is found to be more remunerative than those of agriculture and industrialization has become a necessity almost in every walk of life.

It being recognized that the employment of more than a limited number of persons in agriculture tends to reduce the average income of the individual and the aggregate income of the nation as a whole, the recent practice in progressive countries has been to provide more work for their labour force in industries and subsidiary occupations and to limit the number employed in agriculture.

The country will be in the process of industrialization in course of time. We have already laid foundation of big dams and irrigation projects.

Reclamation and irrigation projects have not only been planned but have been put into gear which are adding annually thousands of high yielding acres and are bringing about a sound and greatly expanded need for farm equipment to assist farmers in producing the foodstuffs needed for our own increasing population. Naturally the demand for the larger and more important tools will undoubtebly exceed more than ever in coming years.

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As the move for industrialization accelerates and our industries flourish the population will move from agriculture to other remunerative industries resulting in shortage of man power on the farm and increase in wages. This would increase the trend of farm mechanization and application of modern farm machinery to more and more farm activities to offset the rising cost of farm labour. Notwithstanding the many uncertainties that face our agriculture industry today, it is probably inevitable that Indian agriculture will be mechanized as that of any other Western Country, but one can visualize that our agriculture should be mechanized in order to keep the level of production upto the mark.

How long shall we continue importing farm equipment worth million of dollars from Western Countries and depend on the mercy of foreign manufacturers? It is very obvious that we will continue imports till we start our own industry making improved implements in India suited to Indian conditions in the economic interest of our own country and for the benefit of our own farmer.

We should design plants capable of producing machinery and Government should give immediate attention and priority to this industry of implement making and engage experts in development of the plant to make a new stage in the manufacturing of agricultural implements. We should produce machinery on the basis what it can do to the farmer rather than copy out the western types.

We may also make some machinery on replacement basis as there is considerable equipment which have been imported and will be imported till we produce our own machines.

We should be happy to note that some machinery have been modified and adapted and have been manufactured wholly or in part in India in fairly large numbers. Examples of this type of machines are small chaff cutter, sugarcane crusher, small plows and cultivators of simple type. In this connection the progress made by M/S Kirloskar Bros. in South India and Allahabad Agricultural Institute in Northern India is quite satisfactory. Uptil now the manufacture of implements in India has been largely confined to cast iron and wood. Most of the implements have been frank copies of imported models. This is probably due to lack of encouragement and absence of research work. Now the time has come when this industry requires the earnest attention and closest support of the Government, leading financiers and businessmen of the country.

The businessmen among the local public should be invited. Commercial and Industrial Association should be asked to furnish suggestions. The Provincial and Central Government should engage local and foreign experts and investigate the possibilities. Great publicity should be given that the industry will prove remunerative which will rouse public interest and will ensure co-operation and small Industrial Projects will emerge in each province for detailed investigation and some of them for execution.

When the Provincial Government find it a success, the representatives of all the Government should meet in their common interest to evolve an all India Plan to bring into existence a central implement making concern. Each province should take upon itself the responsibility to start and maintain an Implement Factory even though at the risk of loss at first. If the responsibility is shared in this way no single province will feel it a heavy burden; while the country as a whole will be able speedily to bring into existence a full fledged factory.

Leading businessmen and large manufacturing concerns in each province should be encouraged with substantial help from Government. If sufficient capital is not forthcoming, the Provincial Government should itself step into the gap, raise loan just as the Central Government have done to construct railways and other irrigation projects.

In the more advanced provinces, prominent businessmen will, in their own interest, combine and come forward to start this industry. Once they began to feel that Government power and resources will be at their back in the event of severe foreign competition or other risks which may be beyond their power to face. If such support were forthcoming, India with its abundance of cheap labour and vast resources could develop this industry which in the long run will definitely better suit to the needs of our cultivators and will improve production as increased production is primarily a function of better tools and implements.

By doing this the people will have the direct benefits, increased skill and higher purchasing power at the same time we will have an internal market and establishment of our own where thousands of our men will be engaged and prosperity will come to Agriculture and we will have the scope for the expansion of internal market greater than we may find any where in the world.

The prosperity and industrial development of U. S. A. were built up on the expansion of their internal market.

BIOLOGICAL PROCESSES IN THE SOIL

By

M. A. Ali, Sabour.

The agricultural soil is a heterogenous mass of sand and clay particles derived from rocks, metallic elements, air, moisture, microorganisms and organic matter which are either already present or are being constantly added in an ideal type of farming. The diversity of the organisms and the interaction of one group upon the another has of recent years received much attention in particular by Rothamsted Workers in England and by Waksman in United States.

The microbial population of the soil consists of Bacteria, Fungi, Actinomycates, Alagae and Protozoa—the accurate idea of the total numbers of which is impossible to get but some idea may be formed by the average estimation of 10-20 millions of bacteria per gram of soil. They like all other living animals require food, air and moisture to keep up the energy for the performance of the necessary activities of life, *e.g.*, locomotion, respiration, reproduction and others. These energies they are able to get from the biochemical action of their enzymic secretion on the different types of elements mostly the organic matter and the elements secured from the rock.

The biological processes relate to these enzymic biochemical reactions of the microbes on the elements composing the soil suggesting that these are continually undergoing alterations attended by the absorption of Oxygen and the consequent evolution of heat. This heat emission becomes greater in F. Y. M. applied to soil and has been found to raise the temperature 1°—2° degress centigrade (Wagner). It is by this change that humus is produced from the organic residues. Other organic acids are also formed which if the soil is deficient in basic material may exert a baneful influence. These changes are mainly brought about by Protozoa, Amœba, Fungi, Algæ, etc.

The nitrogenous parts of organic compounds are probably broken down yielding first Ammonia :—

$$CO{<}^{NH_2}_{NH_2} + H_2o\,(\text{Hydrolysis}) \rightarrow 2NH_3 + CO_2\,.$$

B. Mycoids, Subtilis and others in decomposing albumin produce ammonium carbonate with small quantities of Formic acid, Butyric acid etc :—

$$C_{72}H_{112}N_{18}SO_{22} + 77O_2 \rightarrow 29H_2O + 72CO_2 + SO_3 + 18NH_3.$$

The ammonia and carbon dioxide in presence of moisture form ammonium carbonate, $(NH_4)_2CO_3$:—

$$2NH_3 + CO_2 + H_2O \rightarrow (NH_4)CO_3.$$

The ammonium compound thus formed from the nitrogenous organic matter quickly oxidise again under the action of bacteria, known as B. Nitrosomonus and B. Nitrosoceus producing HNO_2 and by further oxidation to HNO_3 by B. Nitrobacter.

(i) $(NH_4)_2CO_3 + 3O_2 \rightarrow CO_2 + 2HNO_2 + 3H_2O,$

(ii) $2HNO_2 + O_2 \rightarrow 2HNO_3.$

Kareer, however, states that some soils contain an organism B. Nitrater which can in one step change ammoniacal nitrogen into nitrates.

The nitrates thus formed are again subject to action of certain organisms like B. Denitrificens which in the ordinary text book manner can be represented as :

$$24KNO_3 + 5C_6H_{12}O_6 \rightarrow 24KHCO_3 + 6CO_2 + 18H_2O + 12N_2.$$

The cellulose and allied substances, *e.g.* Lignin, of the organic matter (non-nitrogenous) changes into water, carbon dioxide and other substances. It is evident that Lignin also decomposes but nothing is known about the organism which brings this change. Waksman suggests that decomposition can be affected by Actinomycetes and certain bacteria but no conclusive proof is available. The Rothamsted Workers have failed to find any such organism inhabiting the soil.

The mineral matter of the organic compound is made soluble similarly by bacterial activities. Iron, Calcium, Silica, Sulphur and others are undergoing chemical change. Sulphur for example is supposed to be oxidised to sulphates under the action of Thio-oxidans and Thisbacillus (Waksman). This reaction is of very great help in alkali soils as the sulphates (Sulphuric acid) react with basic materials making it neutral and hence non harmful. Sulphur on this very account is used in alkali soils.

In marked contrast to general disintegrating action of bacteria we have another group which synthesize their body Protein from the atmospheric nitrogen and which in turn

eventually become available to the soil. The action of these (Azotobacter, Amylobacter, Clostridium, Radicicola) can be represented thus :—

$$\begin{tikzcd} \text{Free Nitrogen} \arrow[r, "\text{Clostridium.}", "\text{Azotobacter.}"'] \arrow[d] & \text{Nitrogen Organic.} \\ \text{Legumes} \arrow[ur, "\text{B. Radicicoda.}"] & \end{tikzcd}$$

The nitrogen in organic bodies undergoes the same cycle of operations until it is available as nitrates.

The microfauna of the soil notably the Protozoa is important in as much as it appears to limit the development of the microflora by their feeding action.

It will be clear from what has been said that it is through this biological process in the soil that complex organic compounds are broken down to simpler compounds which benefit the soil as well as the crop. In short, without the presence of this process the soil would soon become unfit for the growth of agricultural crops and plants.

A NEW SEEDING METHOD

M. VAUGH.

All through North India especially, agricultural workers have recognised the need for better seeding methods. It has been recognised that unless the seed is deposited at the right depth, in moist soil, with the requisite cover, neither too much or too little, there was an initial limitation on the crop which might limit its yield. Correct spacing of plants has also been recognised as important—that is, the seed rate per unit area must be correct for best results.

Broadcasting by hand gives little or no control over any of these factors. While a skillful man may put the correct amount of seed on a unit area, only a part of the seed will be buried to the correct depth. Distribution of the plants on the soil, that is the distance from plant to plant, will depend therefore not entirely on the skill of the sower but partly on the chance of which seeds get covered so that they germinate properly.

On irrigated land or during the rains, the conditions are favourable in that ample moisture is present, allowing the seed to be planted shallowly and still give good germination. Under these conditions, it has been fairly easy to use imported seed drills and some fairly successful local models have been produced which give automatically dropped seed with consequent uniform spacing and correct planting depth. In much of the U. P., as well as other neighbouring provinces, much of the winter crop is planted on unirrigated land. This means planting under a deep soil mulch.

The Agricultural Institute early faced this difficulty. It purchased small American seed drills. The seed dropping mechanism of the so-called fluted roller type was efficient and could be adapted to most of the common crops, both *kharif* and *rabi*. The original furrow openers of the disk type worked quite well seeding shallowly on well prepared fields where the moisture was ample and near the surface They failed entirely when used for deep seeding under a 3" to 4" soil mulch. Larger diameter disks designed for seeding under these conditions were secured and tried but it was finally found that for seeding under a deep mulch, the hoe type was better.

The local method of seeding winter or *rabi* crops in the area around Allahabad had been and still is to seed through a bamboo spout tied behind the wooden plow. This device, in the hands of a skilled man, does an excellent job of placing

the seed at the right place. Carefully used, it puts the seed at the bottom of the mulch, does the right amount of furrowing so that the seed, though planted deeply from the surface is not covered by too much soil. The method has two defects: it is dependent on the skill of a person to drop the seed at the right amount and it seeds a single row at a time.

An attempt was made to rebuild the American seed drills to do a multiple row job of seeding, which would utilise the accurate automatic seed dropping mechanism but which would place the seeds in a similar manner to the wooden plow. It was found possible to modify the depth adjustment to get the hoes down to the proper depth without difficulty. However, if comparatively narrow hoes or furrow openers were used, the furrowing effect was limited and the seeds were buried too deeply by the soil flowing round the hoes. When the width of the hoes or furrow openers was increased to get the required furrowing, we found that the space between furrow openers was not enough and the soil tended to bridge across from one to the other and clog the drill. Partly to keep the cost down and partly for ease of handling in small fields, we had kept to the traditional 2-wheeled pattern. With two wheels only, setting the furrow openers further apart front and back, that is staggering them so that some were forward and some behind the axle got better separation and reduced clogging but made it difficult to get uniform depth of planting. Any little change in yoke height meant that one set of furrow openers worked at a different depth from the other. By changing the row width or spacing to about 12″, we found that we could use furrow openers which did the requisite ridging, placed the deed at the required depth without burying them under too much soil and did not clog between hoes due to the soil bridging from one to the other.

The drills so evolved worked well. They could be set for shallow or deep work. They could be regulated to drop the required seed rate quite accurately. They were within the power available from one pair of medium bullocks. They still had two defects, one we feel mainly a matter of custom, the other real. The 12″ spacing is not traditional and therefore is suspect. However, it seems necessary for those seeding under non-irrigated conditions to choose between deep mulches and narrow spacings. It would doubtless be possible to design an etirely new frame with 3 or 4 wheels instead of two and with hoes widely separated front to back, which could successfully sow under deep mulches with the necessary

ridging and without clogging. Evidence at present does not indicate that the closer spacing is necessary for maximum yields. The changes while being technically feasible, would increase the real defect, that of cost. We have found the selling price necessary to profitably market the drills is about Rs. 350 each. At this rate, they are certainly out of the reach of the ordinary cultivator as a personally owned machine. Whether they can satisfactorily be made available to such cultivators by some cooperative ownership, loan or hire basis, remains to be seen. For farmers having large areas to seed, they are certainly practicable and desirable.

This left the problem of the small cultivator still unsolved. While automatic control of the seed rate is certainly desirable, correct placing of the seed seemed to be more important. Various attempts to introduce the multiple row seeding devices commonly used in the central and southern parts of India into the area around Allahabad had not proved successful, apparently for much the same reasons that the imported drills had not worked. These devices however, did give one clue. They showed by the success with which they are used in their own areas that hand dropping of seed into a funnel was not basically different or more difficult for several rows than for 1 row. Results with other types of *attachments* had not been particularly encouraging but a seeding attachment to be fitted to the ordinary plow was in common use. Could we find or make an attachment for either an existing implement or one we considered it desirable to introduce?

After studying the problem for some time, we decided that the ordinary cultivator or bullock hoe offered best possibilities. Some demand for cultivators had already developed in the province. We had used ordinary cultivator shovels as the furrow openers on our grain drills quite successfully. The cultivator could be adjusted to work deeper or shallower in the ground and the lines could be put closer or farther apart. Basically, handling the cultivator did not require any different type of skill from that required to handle a wooden plow, either for the man driving the bullocks or for the woman dropping the seed.

In 1945 an attachment having a funnel with three outlets and pipes was made for a Shabash cultivator. The three back shovels of the cultivator were used, the two front ones being taken off to lighten the load. It was used for seeding wheat, part of a field being seeded with the attachment and part with

a seed drill. The man operating the cultivator was experienced and had worked for some time as an operator of experimental equipment. The woman who dropped the seed was an ordinary laborer on the Institute farm and claimed not to have even seeded with a single ordinary spout before.

The results were surprisingly good. Except that the rows were in sets of 3 while those seeded with the grain drill were in sets of 5, it was difficult by observation to tell which part of the field had been seeded by which method. Germination was quite uniform, the seed distribution was good and unexpectedly uniform between rows seeded at the same time.

The same attachment, with the help of a second one, has been used for seeding the whole of the *rabi* crops on the experimental farm of the Agricultural Engineering department for the last two years. Different persons have operated the equipment, both the men handling the oxen and cultivators and the women dropping the seeds. The results have been satisfactory throughout. In *rabi* seeding, there has been partial failure only in one or two very poorly prepared fields. Where there are large clods some trouble may be encountered. Fairly heavy trash has caused less trouble than with the grain drills, very little in fact. It is easy to lift the cultivator and clear it of trash at any time, almost without interrupting the seeding. On reasonably well prepared fields, results have been excellent.

So far about 4" wide cultivator shovels have been used and rather makeshift spouts have been bolted between them and the standards. It is believed that better results would be gotten from special hoes, made to entirely replace the cultivator shanks. While our work was done with shabash cultivators, it seems probable that similar attachments could easily be made for the so-called Cawnpore cultivators, or for the imported ones such as Planet Jr. or McCormick-Deering. Details would vary but capable local mechanics should be able to work them out without difficulty. The greatest difficulty with the abovementioned cultivators is their low clearance above the ground which may cause some difficulty getting sufficient depth for seeding under a deep mulch. For shallow seeding where moisture is ample they would work all right. Some trials were made of a cultivator having a stiff beam like a wooden plow. This appears to have some advantage for seeding and further trials will be made with it.

The same arrangement has been tried for seeding *kharif* crops to get them in lines so they can be intercultured with bullock drawn implements. For this, the middle spout to the rear cultivator shovel is stopped up with a bit of clay or rag and only two rows are seeded at a time 30" apart. The result with this have been less satisfactory. On loamy or sandy soil, not too wet, results have been excellent. On heavier soils, especially when somewhat too wet, results have been poor. It is believed, however, that wherever if is now the practice to seed with wooden multiple row seeding devices, this attachment can be adapted. On heavier soils, it will be necessary to exercise more care as to soil moisture conditions in choosing the time to sow and possibly it may be necessary to be more careful to seed before the rains become too heavy. Less difficulty is experienced with large seeded crops like maize than with smaller seeded crops like juar and more especially bajri. The saving in human labour from doing interculture instead of hand weeding justifies some care and attention to this point.

Even if used only for the *rabi* crops, the advantages of multiple row seeding in saving time and labour at a season when there is a heavy rush of work will justify having the attachment. If it is available and can be used for the *kharif* season as well, and if the same cultivator can be used for the subsequent interculture of the crop, additional advantage is gained. It would appear that this attachment is sufficiently advantageous to justify it being tried in widely scattered areas to see whether it has local application or not.

MANURING OF POTATOES FOR BIGGER YIELD TO COMBAT INDIA'S SHORTAGE FOR FOOD CROPS

By

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Potato is a crop that can be raised at least twice a year and can give a yield of four to five hundred maunds an acre in the whole year. Compare this with cereals whose yield is anything from 20 to 30 maunds. It takes only three to four months for a potato crop to grow while cereals take six months. Besides this, the response to manuring is much more in the case of potatoes than in the cereals.

The result of this finding on our food problem can be seen from the fact that we can feed 25 to 50 people more per acre of our land by potato cultivation and can fight effectively with our present shortage of cereals. Our shortage of cereals becomes all the more acture now when Pakistan has declared that she cannot spare even an ounce of rice or wheat from its area. A surplus of 2 million tons has vanished altogether from our midst. Even if we try to bring all the available land in cultivation it cannot be done so quickly. We can, however, convert a cultivated field to yield a crop given larger returns. Thus a case for potato cultivation extensively is established. To cultivators it would not mean any loss. The cash return on the crop would be such as to pay back all their extra investment in the form of seed and manure. In South and specially in Nilgris potato cultivation and its marketing has been highly developed. Besides this large number of manurial firms are operating to meet with all the requirements of the manure in that area.

Looking on the manurial requirements of the potatoes we find that Nitrogen leads to vegetative growth, phosphate helps in grain and root formation and potash helps in photosynthesis and checking susceptiblity to disease. Potato being a root crop, phosphate are bound to play an important role. In India various types of manures are obtained in the forms given here; nitrogen in the form of Ammonium Sulphate, Nitrate of Soda, various varities of cakes and farm-yard manures; phosphorus as Super Phosphate and bone meal; Potassic manure as sulphate of Potash, Muriate of Potash or Wood Ashes.

The manures can further be classified into organic and inorganic both have their own advantages. Whereas the organic, *viz.*, cakes, bone-meal, compost or farm-yard manures, etc., are of value for encouraging Bacterial life and improving physical conditions such as aeration, water retention, etc., the inorganics are of value as suppliers of readily available plant, etc., the inorganies are of value as suppliers of readily available plant food in a concentrated form.

Requirement of plant nutrient for potato crop :—An average good crop of potatoes giving a yield of 200—250 maunds per acre removes from the soil 80—100 lbs. nitrogen, 35—40 lbs. phosphoric acid and 140—150 lbs. Potash. Based on these results in Northern India an addition of 80—120 lbs. of nitrogen, 35—60 lbs. of phosphoric acid is recommended. Field experiments, however, show that potassic fertilizers do not give any encouraging results.

Besides these nutrients this crop needs good aeration, suitable moisture retentive capacity and neutral to slightly acidic re-action of the soil. This is achieved by growing the crop in a well drained light loam soil and supplying enough of quickly decomposing organic matter. It is a good policy to combine organic manures with quick acting fertilizers.

Manurial Scheme :—Manurial schemes are being given below and even if we take an increase of 100 to 150 maunds per acre of potato crops due to manure we can make a profit of Rs. 250 to Rs. 400 per acre on each crop after paying for manures and keeping all other expenditures the same. Any one of these may be adopted.

1. Apply a mixed fertilizer consiting of organics and inorganics, *e.g.*, cake, horn-meal, Sulphate of Ammonia and Super Phosphate in suitable proportion. This is done by applying Humophos No. 1 or No. 3 at 8 –10 or 10—12 maunds respectively per acre at sowing. The manure is mixed with soil around each tuber. At the prevailing rates this will cost about Rs. 110 to Rs. 130 per acre.

2. Apply Caster cake at 12—15 maunds, farm-yard manure or compost at 5-6 tons or horn-meal at 4 maunds per acre at sowing except for farm-yard manure or compost which should be supplied 15-20 days earlier. Apply also Super at 2-3 cwts. per acre at sowing near the tuber and top dress 2 cwts. per acre Sulphate of Ammonia with earthing. This is estimated to cost Rs. 125 to Rs. 150 per acre.

3. Apply 6-8 maunds Humuphos No. 2 at sowing followed by 2½—3 cwts. Sulphate of Ammonia top dressed with earthings. This is recommended only where the soil is not very light and is rather well supplied with organic matter. It is likely to cost Rs. 105 to Rs. 120 per acre.

4. Apply manure mixture No. 3 or Super Phosphate at 3 cwts. per acre, followed by a top dressing of 2 cwts. Sulphate of Ammonia at earthing. This is recommended only where a large residue of Farm yard manure from the previous crop is available. This is estimated to cost Rs. 105 to Rs. 120 per acre.

The material content of the various manure mixtures mentioned above are as follows and are obtainable from the D. C. M. Chemical Works, P. O. Box No. 211, Delhi. Ammonia Sulphate is the I. C. I. product and the distribution of this is in the hands of the Government of various provinces.

			N	P205
1.	Humo Phos No. 1	contains	10%	5%
2.	„ „ „ 2	„	4%	6%
3.	„ „ „ 3	„	8%	6%
4.	Manure Mixture No. 3	„	3%	0·15%
5.	Super Phosphate	„		18%
6.	Amm. Sulphate	„	20·6%	16%

Soil Conditions, Rotations and Fertility:—Potatoes are grown on a variety of soils varying from sandy loam to clay loam. The common rotations are potatoes-maize; potatoes-tobbaco-maize; potato, etc. The does of manures recommended in 1 to 3 above are for a light loam soils and for recuperative rotations the lower dose should be used and may even be further reduced. It should be borne in mind that though good yield may be obtained with the application of 4-6 cwts. of Sulphate of Ammonia for a year or two, gradually the crop quality becomes poor, disease resistance becomes low and the fertility declines a lot.

ECONOMIC SELECTION OF FARM TRACTOR

By

B. M. Govil.

Owing to the rapid changes in tractor design and equipment and in crop production methods much information is required about the tractor before purchases are made.

General considerations :

There are few questions should be considered such as—

(1) Whether animal or mechanical power or both can be utilized profitably on a given farm.

(2) Cost of mechanical power compared to other for doing the same work.

(3) Application and its adaptability.

Kind of power to use :

The following are the principal factors to be considered which are suitable in choosing kind of power for a given farm :—

1. Size.
2. Topography of the land.
3. Crops and kinds of farm.
4. Soil characteristics.
5. Size of fields.

The size of the farm on which a tractor could be used profitably was seldom less than 80 acres, and some investigations showed that farms considerably larger than this could be operated about as profitably with bullocks alone. Now that tractors are available that will successfully perform all operations in field and thereby eleminate the need of bullocks, the size of the farm on which a tractor can be used with profit might be as low as 40 acres. In larger fields there is less loss of time and more efficient work but the smaller tractors are now capable of being handled easily in small or irregular fields containing as few as 5 to 10 acres.

Power for a farm should be selected which can do numerous jobs both tractive and stationary. If a tractor can be used for doing these jobs then it will be a profitable investment. In other words, the greater the amount of time the machine is kept busy, the lower the cost per H. P. hour of

power developed. Use of the tractor on hire basis often solves the problem of whether to buy a tractor or not. There are some individual problems on each farm when power requirement and choice of equipment are being considered.

1. Variation in the managing and mechanical skill and personal likes and dislikes of the farm operator.
2. Differences in type of farming.
3. Size, topography, soil condition, plan for future development, relative cost of labour.
4. Available capital.
5. Climatic conditions.

There are some benefits when tractors are substituted for animal power.

1. Work can be done in the field more efficiently.
2. Man labour requirements on the farm can be reduced.
3. Cost of production per acre can be minimised.
4. Increase in the crop yield because of a better seed bed may be prepared or crop may be planted in better season.
5. Better and faster work can be done by adjusting improved and special implements.
6. Larger tractors with multiple hitches pulling several plows or two or three different tools at the same time permit one man to handle for example large acreage of grain.

Selecting the tractor :

The selection of the proper type, size, and make of tractor for a given set of conditions is frequently a perplexing problem and may be the one factor that determines the success of failure of mechanical power on a certain farm.

In general in selecting a tractor the three fundamental considerations are :

1. The type.
   (a) should it be a general purpose or it be an all purpose machine ?
   (b) If general purposes should it be a wheel or track type ?
2. The size.
3. The make.

Choice of type:—The acreage and kind of crop determines the type of a tractor best adepted to a given farm. If row crops are to be grown as corn, cotton, either alone or with wheat, barley, oats, and similar broad cast crops, the all-purpose or row crop tractor can likely be utilized to best advantage and with great efficiency. This type is well for dairy and general grain and livestock farm because of variety of power jobs which arise. For grain and other farming the ordinary general purpose tractor of the wheel or track type is most suitable.

The following are the points to be considered for the choice of a wheel or track type tractor :—

Wheel tractor :
1. Low cost.
2. Less complicated than tracks.
3. Expense of up keep less on wheel tractor.
4. Riding easier on rough ground for the operator.

For track type tractor :
1. Better traction on loose soil.
2. No packing of the soil.
3. Quicker and shorter turning.
4. Less damage to road surface.

Both types of wheel have their merits and other factors such as the kind of work to be done, the maximum justifiable investment dealer's service facilities and even personal preference may like wise be involved.

Size of tractor :—The choice of correct size of tractor is important, particularly if the farm setup justifies the purchase of an all purpose tractor. There are three distinct types of tractors now available in the market. In general for small farms or for large farms, made up of small fields, the small or two row size will prove most satisfactory. On the other hand large farms have large fields, a larger tractor capable of handling a three bottom plow and four-row planters and cultivators will likely prove more economical.

If the praticular set-up requires a standard type four wheel or track type tractor, them a choice must be made between sizes ranging from a machine rated 10 H. P. at the draw

bar and capable of handling a two bottom plow to machine rated as high as 60 or 70 H. P. at the draw bar which can pull 10 ploughs.

Larger machines are found favourable for a specialized type of farming. For example in large scale wheat production, but some persons are in favour of using large tractors and perform the different operations of ploughing, harrowing and drilling all at one time. At harvest time these same tractors may pull a large combine or two medium size combines.

15-30 to 20-40 size tractor can be used on a farm ranging from 100 acres to 1,000 acres. They will handle two 12 or 14 ft. grain drills and a 12 to 20 ft. combine.

There are certain other jobs for which a tractor can be used such as subsoiling, land cleaning and drainage, terracing, road construction and grading and heavy hauling.

The large tractor can also operate large size threshing machines, saw mills, water pumps, rock crushers, and similar heavy belt driven machines.

Make of tractor :—The choice of a make of tractor is a factor of major importance. The following points should be considered in connection with the make of tractor :—

1. Cost of power during the life of the tractor, based upon initial cost, operating expense, repairs and probable life.

2. Design and constuction of the tractor itself, including quality of materials workmanship, accessibility and dust exclusion.

3. General suitability of the tractor to the kind of work to be done.

4. The general satisfaction given by the tractor after working for a considerable period under similar conditions on other farms.

5. Availability of spare parts easily and minor repairs can be done easily.

6. Stablity and business reputation of the manufacturer.

In selecting a tractor, construction and design should be observed closely. This is important from the point of durabi-

lity, service, accessibility and adaptability to the kind of work to be done parts requiring frequent adjustment should be accessible, and lubrication should be simplified but positive. It should be convenient in operation. Ease of steering, control levers that are readily manipulated, good rear wheel fenders, a well located belt pulley to facilitate lining up, and a convenient and properly protected power take off.

The success of a tracter often lies with the dealer. He should be able to provide his customers with prompt, reliable and competent service. The dealer must have a thorough knowledge of the merits, construction and operation of the machine that he sells or he should employ a man who is so trained. Only this type of dealer can secure the confidence of the trade and thereby carry on a successful business. In addition, an efficient tractor dealer maintains a reasonable supply of staple repair parts and always makes a special effort to obtain, without delay, those parts that he cannot afford to stock.

AGRICULTURE AS A CULTURAL SUBJECT.

By

E. D. Burton, formerly President of the University Chicago.

It has long been a favourite theory of mine that agriculture could be made one of the most cultural in the whole range of studies and an agricultural school the centre of a very high type of culture. For has not agriculture intimate relations with chemistry and physics, with botany and zoology, with transportation and with commerce, with banking and the development of society, and with politics? Has it not indeed its esthetic aspects, and its possible relation with fine arts? And might it not be possible so to educate the farmer that he should be conscious of these relationships, that his daily task should relate itself in his mind on the one hand to the great world of the physical and vital forces and on the other to the evolution of society and the trend of history and the making of a better world for children to be born in and men and women to live in?

(A. M. N.—No. 19—July 1936.)

BACK-CROSS METHOD IN PLANT BREEDING

By

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CONTENTS

I. *Introduction* :

A considerable work has been done in the field of evolution of strains of different crops by the common methods of selection and hybridization with appreciable success, but the progress in this direction has been remarkably advanced by application of the recent back-crossing method. Harlan and Pope (1922)*[2] pointed out its probable value in small grain breeding, and stated that it has been largely, if not entirely, neglected in any definite breeding programms to produce progeny of specific types. They suggested the probability that there were many instances in which back-crossing would be of greater value than the more common method of selecting during the segregating generations after making crosses.

One of the ways in which back-crossing is particularly valuable is in adding disease resistance to a variety that is commercially desirable in all other respects.

II. *Review of Literature* :

Briggs (1938)[1] suggested that the back-cross, most useful in the transfer of specific characters, such as resistance to

*Figure in parenthesis indicates literature cited.

diseases and insects, is based on the simple fact that a heterozygous population back-crossed to either homozygous parent would become homozygous for the genotype of the recurrent parent. The proportion of homozygous individuals in any back-cross generation is the same as would result from an equal number of selfed generations and may be expressed by the following well-known equation:

Proportion of homozygosity $= \left(\frac{2M-1}{2M}\right)^n$ where "n" is the number of pairs of heterozygous factors and "m" is the number of generations of selfing or back-crossing, as the case may be.

Richey (1927)[12] has given the percentage of plants homozygous for "n" factors entering the cross only from the recurring homozygous parent in each of "r", successive generations calculated from the above formula.

TABLE I.

Percentages of Plants Homozygous for "n" factors entering a cross only from the Homozygous Recurrent Parent (from Richey.)

Number of factor pairs. n	Number of generations of back-pollinating, r									
	1	2	3	4	5	6	7	8	9	10
1	50	75	88	94	97	98	99	100	100	100
5	3	24	51	72	85	92	96	98	99	100
10	..	6	26	52	73	85	92	96	98	99
15	..	1	13	38	62	79	89	94	97	99
20	..	..	7	28	53	73	85	92	96	98
30	..	..	2	14	39	62	79	89	94	97
40	..	..	..	8	28	53	73	86	92	96
50	..	..	..	4	20	46	68	82	91	95
75	..	..	..	..	9	31	56	75	86	93
100	..	..	..	..	4	21	46	68	82	91

Richey (1927)[12], also gave a summary of the number of plants required in F_2 and the first back-cross generation to obtain a single individual with the required genotype when one to eight factors were involved. These results which are calculated on the basis of independent inheritance are given below:

TABLE II.

Progeny required to have one Dominant Homozygous Individual (from Hays and Emmer.)

Method.	Number of factor pairs.							
	1	2	3	4	5	6	7	8
F_1 Salfed	4	16	64	256	1,024	4,096	16,384	65,536
F_1 back-crossed to homozygous dominant	2	4	8	16	32	64	128	256

The above table clearly shows that with the difference of five factor pairs in the parents the calculated expectation in F^2 is only one individual out of every 1,024 with all 5 factor pairs in a dominant homozygous condition, whereas for the first back-cross generation, the theoretical expectation is one out of every 32 that contain all 5 factor pairs in a dominant homozygous condition. If more factors, say 20, are involved in a breeding programme, the problem becomes complicated, but if these 20 factor pairs are inherited independently in a back-crossing programme, there is a rapid elimination of those characters coming from the non-recurrent parent except the desired one or two characters for which the non-recurrent parent has been used in the programme under question. With each re-cross the genetype of the non-recurrent parent is reduced to one-half for characters like shape and size of the seed color and other undesirable characters. Thus in five back-crosses only 1/·64 of the genotype does not possess the character of the recurrent parent of commerce which has retained by selection at the same time, the important desirable characters of the non-recurrent parent with which it was crossed in the beginning.

Briggs (1938)[1] assumed 21 factor pairs governing yield, quality, adaptation, awn character and resistance to stem rust in the cross, Hope and White Federation wheats. In F_2 of such a cross the White Federation genotype would

occur only once in 4,398,046,511,104 individuals and to grow such a population would require over 50,000,000 acres of land which is about the area normally planted to wheat in the U.S.A. This is really a complicated problem to be solved by segregation programme where there would be 2,097,152 homozygous genotypes which are all different. If the above hybrids are inbred for 5 generations, approximately half of the population will be homozygous and equally divided among the genotypes mentioned above. If, instead, back-crossing is practised and 5 back-crosses are used, the same degree of homozygosity is attained but only one homozygous genotype of the recurrent parent will be present. This is a great advantage to plant breeders.

The frequency at which the successive back-crosses may be made will depend on the ease with which the character to be transferred can be followed in hybrid population. In may cases considerable progress can be made by selections at the end of the first back-cross. After the third or fourth back-cross, the material is so nearly like the recurrent parent that selection for characters other than the one being transferred is not very effective.

Much has been and can be accomplished in the direction of evolving disease and insect resistant varieties by back-crossing programme. This method is admirably suited for such improvement. Even the characters such as yield or quality can be improved to a great extent if one parent of the hybrid is more desirable commercially than the other.

It will also be necessary to consider the question of linkage in back-cross method of breeding. Linkage between favourable factors would be beneficial to the program of improvment, and especially when it is known, larger population should be grown. Success in obtaining any desired combination would be inhibited only if the factors concerned were linked so closely that no crossovers could be obtained. This would be equally inhibitive under any other methods of breeding but any given linkage would interfere less under back pollinating than under selection within selfed lines.

III. Specific plan for using back-cross on one crop, as an example of the method.

(a) Review of literature on Blackeye (cowpea) improvement on Fusarium wilt.

The project of improvement of wilt resistant Blackeye beans (cowpea) in California has been cited as an example in this paper. Cowpeas are called peas in the Southern United States. In California the one type grown is known as the Blackeye bean. In the southern U. S. A, where cowpeas are more generally cultivated than elsewhere, they are used as snap bean pods, green shelled peas, dry beans and also as forage and covercrops. With the increase of Blackeye production in California, disease to which the beans are susceptibe began to appear. The most destructive and virulent was Cowpea wilt, caused by the fungus strain Fusarium *Oxysporium f. tracheiphilum* which is specific to Cowpea only. Other diseases such as root-knot nematode and Sclerotium rot are also quite common. Sometimes the wilt attack has been so severe in California that entire fields have wilted after some period.

In 1929 Professor Mackie was assigned the task of breeding Blackeye beans resistant to this destructive disease and he came to the rescue of farmers with the wilt-resistant variety, Blackeye 5.

In his breeding work he used Iron Cowpea as the resistant parent after testing for resistant stocks in the nursery. The Iron Cowpea is unlike the Blackeye in many characters. It is a bit late in maturity, unusually viny and has a very hard small brown seed unfit for human consumption. Blackeye is early in maturity, and yields a high crop of very large white coated seeds with black eyes, quite suited for human consumption.

Mackie (1946)[11] made crosses between old Blackeye and Iron and tested the F_1 and succeeding generations in a heavily infected sick soil. He used Blackeye as the female parent. He followed the method of backcrossing F_1 to California Blackeye. He continued back-crossing to the fourth and sixth generations and carried further only those crosses made on disease resistant plants. The F_1 was black, showing dominance over brown seed color of Iron, but the desirable seed coat character of Blackeye was restored after back-crossing and rigid selection. The viny character was dominant and so it was easy to fix the oval, upright types of Blackeye as it was recessive. He also selected some viny types for forage or covercrop varieties. Disease resistance was found to be dominant over susceptibility. The number of factors involved in disease resistance could not be determined as many diseases were involved. Thus beginning with the fourth and sixth

backcrosses, thousands of disease resistant selections were tested under severe disease attack in the plant to row plots. The best of these were increased and placed with bean farmers. These first distributions were not fixed in all characters, but further selections involving hundreds of plants from each strain were tested. These tests resulted in varieties much improved in resistance to disease attack especially wilt and thus the Blackeye 5 originated.

Kendrick (1931 and 1936), [5 & 6] worked on Fusarium wilt resistance. He found out from field trials in 1928-29, that Virginia Blackeye cowpea was highly resistant to wilt, but not adapted to California cultural practises. Hybrids from crosses between the California and the Virginia blackeyes were highly resistant, but tended towards extreme vegetative vigor, irregular and light seed production and somewhat small seed. Repeated planting on sick soil, extensive single plant selections and back-crossing to the susceptible California blackeye resulted in several strains highly resistant to both Fusarium wilt and root-knot with increased production and less vigorous vines of commercially desirable seed types.

(*b*) *Short description of Fusarium wilt organism*:

A short description of the attack of the organism will be of interest. The wilt of Cowpea (*Vigna sinensis*) caused by *Fusarium Oxysporium f. tracheiphilum* is a serious factor in nearly all the sections of California where Blackeyes are grown. In many cases the soil has become so thoroughly infested with the wilt that the growing of Blackeye is no longer profitable. The increasing severity of the disease has forced some growers to use new areas for growing Blackeyes in California.

Orton (1902 and 1909) [7 & 8] said that the Cowpea wilt does not appear until the plants are about six weeks old. At first a few plants are noticed throughout the field with pale green flaccid leaves, which soon turn yellow and drop from the plant. The plants showing the disease early in the season usually die prematurely and fail to mature seed. As the season advances, more and more plants show the disease as evidenced by their dwarfed condition, yellowness, and in many cases death of the infected plants. When the stems of such plants are examined more carefully the vascular system shows a darkbrown mass of disintegrated tissue with only the outer cortical area showing evidence of life. The vascular discolora-

tion often extends throughout the plant. Since many diseased plants mature seed, the possibility that the fungus responsible for the disease might be carried with seed is likely.

Generally the fungus enters the plant from the soil through the smaller roots and grows through the water ducts of the skin, until it may be found in advanced cases, even in smaller branches and petioles of the leaves. The mycelium is nearly white, but it causes the walls of the vessel to become deeply stained. Some of the vessels of the plant are completely filled with interwoven hyphae of the fungus and the supply of water and plant food carried from the roots to the leaves is greatly diminished. The appearance of the plant affected by the disease indicates that it is suffering from lack of water. The diseased areas in the fields increase in size quite rapidly by direct growth from the edges which is due to the spread of the mycelium through the soil.

The degree to which disease resistance is inherited is naturally a matter of fundamental importance to the plant breeder. Disease resistance is a protective quality developed by the species as a result of the struggle for existence with the parasite. The chances for success in breeding for disease resistance will, therefore, be seen to depend on the nature of the parasite, its degree of adaptation to the host species, the length of time it has been prevalent and the possibility of crossing the host with related resistant forms. Breeding for disease resistant varieties, therefore, cannot be considered as permanent when a resistant variety is secured. Not only is the variety itself subject to variation through mutation and field hybridization, but the disease itself is subject to the same variations (Mackie and Smith, 1935).[10]

Similar things happened to Blackeye 5 evolved by Mackie which did very well for several years. Lately, however, Blackeye 5 has shown some susceptibility evidently to a new race of the wilt organism (Fusarium). Iron cowpea is still highly resistant to the Fusarium wilt and other diseases. So a breeding programme has been formulated at the Agricultural Experiment Station, Davis, in 1946 to improve old Blackeye and Blackeye 5 by following the back-cross method to obtain greater resistance in Blackeyes. The work is under progress at the experiment station since 1946, according to the program described in this paper.

(c) *Detailed plan of improvement :*

Plan of improvement by back-cross method of Blackeye is outlined as below :

Selection of parents for crossing.—A variety of Blackeye (A) with desirable characters but lacking in one character of disease resistance. The variety Iron (B) containing the high of degree disease resistance which the Blackeyes lack.

Selection in the selfed progeny.—From plants carrying the factors obtained from Iron, *i.e.*, disease resistance, until homozygosis for this character is obtained. In the case of self-pollinated crop such as Blackeye, the new lines obtained, may be compared with each other and with Blackeyes in field trails. The strains of greatest promise may be increased and distributed as improved varieties if their performance is satisfactory.

The first cross was made in 1946 between (I) Blackeye 5 X Iron curd (II) old Blackeye X Iron. The F_1 has been grown in 1947 and the resistance to wilt disease has been found to be partially dominant in both crosses. The crossing with old Blackeye has been done to study the comparative degree of resistance of Blackeye 5. The F_2 seeds are in both cases unicolored black. Back-crossing F_1 plants to both Blackeye 5 and old Blackeye has been done this year for further selection to obtain the desirable plant and seed characters of Blackeye of commerce while rigid selection will retain the disease resistance of the Iron cowpea. The following details of plan may be followed in this improvement programme :—

1946, 1st year—Parents-Blackeye 5 and Old Blackeye (commercial but susceptible varieties) X Iron cowpea (wilt resistant).

1947, 2nd year—BC $_1$-F $_1$ (resistant progeny) (self-colored-black) X Blackeye 5 or Old Blackeye.

1948, 3rd year—Back-crossed plants segregate resistant: susceptible. The selfed F_1 segregate into many colored types of beans. The back-crossed plants segregate into 1 self colored : 1 white seed coat with blackeyes. Self colored types will be rejected as they are not desirable. Only the Blackeye types which are resistant will be kept. From known color factors, it can be predicted that for color there will be 4 types in equal number : 1 *Rbwh* black self : 1 *Rbwh* black holstein eye : 1 *Rbwh* black watson eye : 1 *Rbwh* black small eye. These last will segregate

1 buff and black and red : 1 buff and black : 2 true breeding small Blackeye. The F_2 will have 3/64 with small Blackeye. There will be 64 buff and 16 red which can be eliminated as not carrying *B*. The BC_1 seeds should be grown in severely infected sick soil of Fusarium wilt disease so that easy way to the rejection of susceptible types can be practised. The other way will be to test these seeds in a green house and cause artificial epidemic of the disease by inoculation of Fusarium culture. Fusarium organism is easy to culture and, therefore, epidemic can be effected easily. Thus the really resistant plants containing resistant genes can be selected.

1949, 4th year—Plants may segregate 3 : resistant : 1 susceptible. Resistant plants should be again inbred and back-crossed to the recurring parent.

1950, 5th year—Resistant parents would segregate giving one homozygous and two heterozygous rows. Further back-crossing to the recurrent parent (Blackeye 5 and Old Blackeye) can be made if all the desired characters have not been obtained. Selection for the desired commercial characters should be made simultaneously in all the selfed generation.

1951, 6th year—BC_3 F_1 X Blackeye. In this way 4 or 5 back-crosses would be sufficient to obtain the resistant type with other desirable characters. Selection should always be practised under suitable disease epiphytotics so that really resistant plants can be selected.

Thus back-crossing should be followed by selfing for some generations in order to get the factors for resistance into the homozygous condition. Secondly it affords all opportunity to select the most desirable lines for further back-crossing.

Summary.

Back-crossing method of breeding is becoming very popular with Plant Breeders because the undesirable factors are eliminated easily.

There is more chance of getting success in a back-cross programme than in a simple hybridization programmo. The reason is based on simple fact that heterozygous population backcrossed to either homozygous parent would become homozygous for the recurrent parent.

It is gaining ground particularly in developing disease resistant varieties of crops. Blackeye 5, a wilt resistant type, was evolved as a result of this method but after a few years the disease began to appear again, probably due to some new form of Fusarium wilt organism. Further improvement of Blackeye has been planned and started at the Agricultural Experiment Station, Davis, California as outlined in this paper.

Acknowledgment :

The writer is thankful to Dr. F. L. Smith and Dr. Catherine B. Madsen of the Division of Agronomy, Davis, for their able guidance in writing this paper.

Literature cited :

1. Briggs, F. N. (1938): The use of the back-cross in crop improvement. Amer. Naturalist, Vol. LXXII, pp. 285-292.

2. Harlan, H. V. and M. N. Pope (1922): Journal of Heridity 13 ; p. 319.

3. Hays and Immer (1942): Methods of Plant Breeding. McGraw-Hill Book Co., New York and London.

4. Jones, D. F. (1942): Proceedings Nat. Acad. Science ; 28, pp. 38-49.

5. Kendrick, J. B. (1931): Seed transmission of cowpea Fusarium Wilt. Phytopathology 21 ; pp. 979-83.

6. Kendrick, J. B. (1936): A cowpea resistant to Fusarium Wilt and nematode root-knot. Phytopathology 26 ; p. 98.

7. Orton, W. A. (1902): The wilt disease of cowpea and its control. U. S. Bur. Plant Indust. Bul. 17. (pt. I) pp. 9-22.

8. Orton, W. A. (1908): The development of farm crops resistant to disease. U. S. Dept. Agr. Yearbook 1908 ; pp. 453-64.

9. Orton, W. A. (1911) : The developmemt of disease resistant varieties of plants. Intert. Conf-de-Guetiguey, pp. 247-61.

10. Mackie, W. W. and Smith, F. L. (1935) : Evidence of field hybridization in beans. Amer. Soc. Agron. Journal 27 ; pp. 903-9.

11. Mackie, W. W. (1946) : Blackeye Beans in California. Bul No. 696, University of California College of Agriculture, Berkeley.

12. Richey, F. D. (1927) : Amer. Nat. 61 ; pp. 430-449.

13. Richey, F. D. (1946) : Jour. Amer. Society of Agron. 38 ; pp. 833-841.

DISCOVERY

By

TOYOH'KO KAGAWA.

I cannot invent
New things
Like the airships
Which sail
On silver wings ;
But today
A wonderful thought
In the dawn was given,
And the stripes on my robe,
Shining from wear,
Were suddenly fair,
Bright with a light
Falling from Heaven—
Gold, and silver, and bronze
Light from the windows of Heaven.

And the thought
Was this :
That a secret plan
Is hid in my hand ;
That my hand is big,
Big,
Because of this plan.

That God,
Who dwells in my hand,
Knows this secret plan
Of the things He will do for the world
Using my hand !

(From "*Songs from the Slums*" *by Toyohiko Kagawa. Copy right* 1935. *Used by permission of the publishers Cokesbury Press.*)

A. M. N.—Nr. 19—*July* 1936.

SUGARCANE IMPROVEMENT IN INDIA

By N. L. Dutt,

Government Sugarcane Expert, Coimbatore.

When the Imperial Council of Agricultural Research was inaugurated in June 1929, it found in the Indian sugar industry a problem of considerable urgency and importance which it could well tackle on an all-India basis. Though the real improvement of sugarcane may be said to date from 1912 with the establishment of the Imperial Sugarcane Breeding Station, Coimbatore, the present renaissance of the Industry followed largely after the coming into being of the Imperial Council. This article gives a brief account of the part played by plant breeding in the improvement of the cane crop in India ; a passing reference has also been made about the antiquity of sugarcane in this country.

Cane has been grown in India from time immemorial. Mention of it occurs in the Vedic literature (5,000 B. C.). Chinese writers of the 8th century B.C. have recorded that knowledge of sugarcane and its products was derived from India. In 600 A.D., the Chinese Emperor, Tsai Heng, sent agents to Bihar in India to learn the art of sugar manufacture—perhaps the first instance on record of a technical commission investigating manufacturing process in a foreign country. Alexander the Great and his soldiers took back with them the sugarcane which they called the 'honey reed'.

There are many reasons for believing that India was the original home of sugarcane, that is to say, of the indigenous Indian canes known botanically as *Sacchrum barberi* Jesw. These canes are thin or medium in thickness (about the thickness of a man's finger). The thicker class of canes like the Cheribon and Caledonian chanes or the famous Otaheite (Bourbon cane), known botanically as *Saccharum officinarum* L. and originally grown in Mauritius, Java, Brazil, west Indies, were probably of South Pacific rather than of Indian origin. The migration of the Indian canes as also of the South Pacific canes in shown in Fig. 2.

The sugar problem :

The area in India under sugarcane each year has been the largest as compared to any other country in the world and yet she was the reduced to the necessity till a decade and half ago of importing sugar to the tune of Rs. 15 crores annually. This anomalous position was due to the fact that the

Centres of Origin of Indian & Tropical Sugarcanes and their migration.

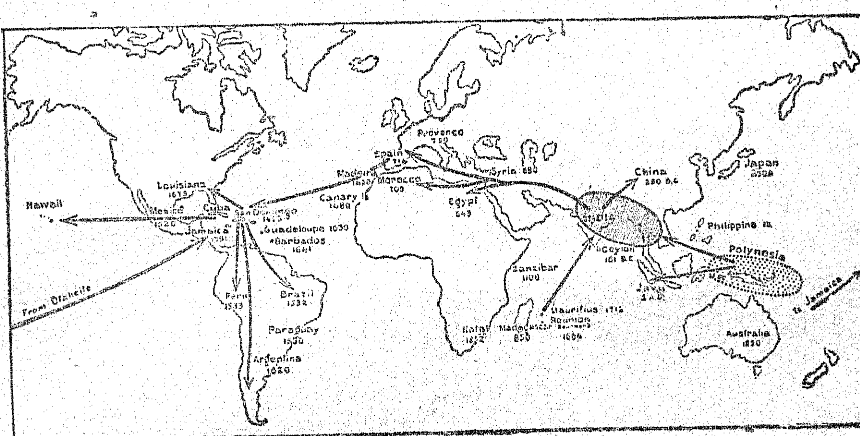
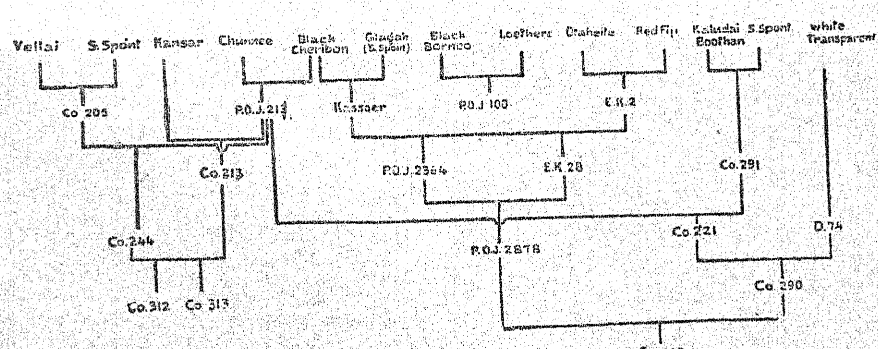


FIG. 2.

FIG. 6.

Diagram of Descent of three prominent Co. Canes.



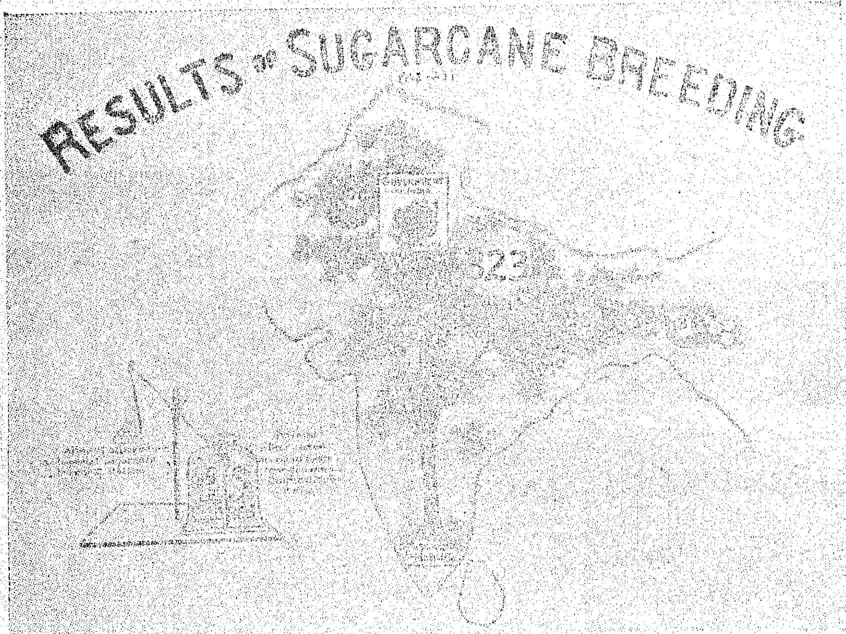
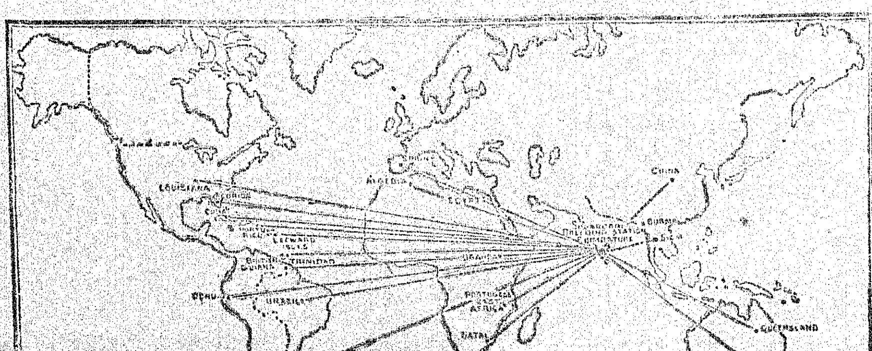


FIG. 6.

FIG 8.

Countries where Coimbatore canes are reported promising



yields of cane per acre were ridiculously low. Over the bulk of the area the outurn per acre in sugar was less than one-third that of Cuba, one-sixth that of Java and one-seventh that of Hawaii. These low yields were largely due to the poor quality of cane grown, some of the varieties grown being the poorest in the whole world. The average yield of stripped cane per acre was only about 10 tons.

The bulk of the cane area (nearly 80 per cent.) in India is in the sub-tropical northern provinces of United Provinces, Punjab, Bihar and Bengal. The whole of this belt is subject to extremes of temperatures, particularly towards the north-west, where there is frost in the winter months.

Breeding Station at Coimbatore:

The Sugarcane Breeding Station at Combatore was started in 1912 in response to a widely expressed desire in the press and legislatures of those days that research should be inaugurated to save the Indian sugar industry, if possible, from the increasingly perilous position to which it was rapidly drifting on account of the large imports of foreign white sugar into the country. It was feared that unless something was quickly and effectively done Indian agriculture might lose from cultivation the sugarcane crop and this would have a disastrous effect on the agricultural economy of the country. The indigo crop had met that fate just then.

Dr. A. C. Barber was the first Government Sugarcane Expert, Coimbatore, and he laid the foundations of sugarcane breeding in India. The evolving of improved sugarcane varieties by hybridization had already yielded valuable results in Java, Hawaii and British West Indies but the problems in India as mentioned above were of a different type. It is to the credit of Barber that the deliberately introduced the wild cane *S. spontaneum* in the crossing operations. This introduced the needed hardiness and frost-resistance in the seedling canes. He also did classical work on the morphology and classification of Indian canes. He retired in 1918 and was succeeded by Mr. (now Sir) T. S. Venkatraman His activities, spread over a period of nearly a quarter of a century, were largely responsible for building up an international reputation for the Station. His great work on the sugarcane *Sorghum* and sugarcane × bamboo hybrids is deservedly world famous. He retired in 1942.

Breeding technique:

The task of developing a technique for breeding canes in India has been one of special difficulty for various reasons.

In north India the indigenous varieties (*S. barberi*) do not usually flower and such of them as do flower do not set seed freely. Very little knowledge was, therefore, available on the flowering and breeding characteristics of the Indian varieties and the Coimbatore Station had to evolve a breeding technique to suit the peculiar needs of the suitation. In addition to some varieties not flowering at all, others are infertile and young seedlings are exceptionally delicate. In Fig. 4 is shown a specially planted 'arrowing plot' in which the varieties flower profusely and are used for crossing purposes. The whitish flowers at the top (some of these are bagged) are technically speaking inflorescences each containing some 40,000 flowers. The flowers are very minute. Another handicap in sugarcane is that the plants from seeds do not necessarily resemble one another or either of the parent plants and the inheritance of characteristics has not yet been traced to any well-defined laws. The procedure followed at the Station is to grow each year about 200 different experimental crosses and to watch the seedlings from the point of view of field yield, tillering propensities, suitability for milling in factories, sucrose content, fibre content, period of ripening and resistance to pests and diseases. The Station has always taken meticulous care to pay as much attention to the underground as to the aboveground portion of the plant. The canes are thoroughly studied for their root system before despatch from the Station.

There is a tremendous range of climatic and soil variation in the different cane tracts and to suit such a big variation and for breeding for each particular tract the Station has drawn upon the different varieties and species of *Saccharum* and even allied genera for breeding purposes. This will be seen from the rather complicated parentage of three of the most important Co canes shown in Fig. 5.

Results acheived:

The energetic way in which the breeding programms have been pursued at Coimbatore has borne substantial fruits in that the improved varieties evolved at the Station have proved undoubted success over the indigenous canes. In 1928-29 the improved Co canes occupied 11·6 per cent. of the cane area in India and in 1935-36 they came to occupy 76 per cent. of the area. There are now several individual important tracts where the Co canes occupy more than 90 per cent. of the area. There is perhaps no other economic crop in which such an advance has been registered

in India. The higher yield of the Co canes has reflected itself in higher over-all average of cane yield in India. Before the advent of the Co canes the average outturn of cane was about 10 tons per acre. The all-India average now is about 15 tons per acre. The money value of this increase to the Indian cultivator even at a moderate comes to Rs. 15 crores (or roughly £ 10,000,000=$ 40,000,000 : Fig. 6). It has to be remembered that some of the indigeneus canes used to give a field yield as low as 150 maunds (about 6 tons) per acre while some of the Coimbatore varieties yield as much as 800 maunds (about 30 tons) an acre. In Fig. 7 is shown the growth of Co213 alongside the indigenous variety Hemja.

The successful canes were Co205, Co210, Co213 and Co214. Two varieties, *viz.*, Co281 and Co290 have also been successful in several cane growing countries outside India (Fig. 8).

Recent development :

Co213 remained practically the universal cane in the North Indian belt but recently (in 1939) it succumbed to the red rot epidemic and had to be replaced. The main canes now are Co312 in the United Provinces and Co313 in Bihar.

Lately the Coimbatore Station also directed its attention towards evolving new canes suitable for the tropical conditions of the more southerly provinces. The outstanding cane which has resulted from this work is Co419 which now occupies the dominent position in the Bombay and Madras presidencies. It yields on an average 35 to 40 tons of cane per acre. In Fig. 9 is shown the growth of this cane against the wonder cane of Java, POJ2878.

The activities of the Coimbatore Station have been expanded to include work on cytogenetics and sugarcane physiology. The Coimbatore Station has also got a substation at Karnal in the Punjab for maintaining a live herbarium of the indigonous varieties as also of the Co canes for proper identification of varieties and for recording botanical descriptions. A study of wild *Saccharums* has been taken in hand and arrangements are underway for undertaking an expedition to different parts of India for a comprehensive collection of the wild types.

In its comprehensive breeding programms the Combatore Station now seeks to meet the growing needs of the cane

grower and the sugar factories in the matter of early ripening varieties, prolonging of the crushing season and disease and frost resistance.

There is now a chain of experiment stations (Fig. 10) in India and each of these stations pays close attention to the testing and suitability of the Co canes to the local conditions. The more important of these stations are fairly adequately equipped for research on agronomical, chemical, and other aspects. Much close attention has also been paid to the diseases and pests of sugarcane.

In 1944 the Indian Central Sugarcane Committee was inaugurated to undertake the improvement and development of the growing, marketing and manufacture of sugarcane and its products on an all-India basis. The Committee has recently sanctioned Rs. 125 lakhs (nearly £1,000,000) for cane development.

Facts about sugar industry:

It is fairly certain that crystallized sugar, as distinct from *gur* or jaggery, was made and used in India in very early times. To come to more modern times, India exported to England an average of 59,373 tons of sugar during the period 1839 to 1847.

In 1900 only two or three factories remained of those initiated in the now distant boom of 1842. The first extension took place in 1904. After the grant of fiscal protection in 1931 the number of factories increased to 155 (Fig. 12). Before the expansion India used to import sugar annually to the tune of Rs. 15 crores (Fig. 11). These imports have now practically ceased.

In certain quarters the opinion was unfortunately expressed that the Indian experiment in protection was perhaps too hastily conceived and was carried out at a rate that from the world sugar point of view could only be regarded as insensate. That this is a thoroghly unjustified view was effectivelys hown by Sir Bryce Burt, the then Vice-Chairman of the Imperial Council in a paper read at the Royal Society of Arts, London, in 1935. He said that in actual fact the grant of fiscal protection was simply the culmination of a long period of sustained effort and that even a cursory study of the TariffBoard Report showed that the fundam ntal improvements necessary to the establishment of an efficient industry had already been secured. It

was doubtless true that the virtual disappearance of India as an importer added to the difficulties of sugar exporting countries. But sugarcane is very important to the agricultural economy of the Indian peasant as it occupies an important place in the crop rotation in several tracts of India and is one of the few valuable cash crops. Sir Bryce, therefore, rightly remarked: 'The development and maintenance of the sugar industry is every whit as important to Indian agriculture as is the encouragemen of sugarbeet cultivation in Europe.'

It might perhaps be added in the end that it was in no small measure due to the self-sufficiency of India in sugar that the sugar requirements of the armed forces stationed in India and the neighbouring theatres during the War as also of the civilian population were fairly adequately met.

Prayers of African Women As They Hoe Their Fields

Father be with me now as I begin to hoe.

You have planned that by working and perspiring people receive their food.

Be with me today as I work together with You.

Hear me, I pray in Thy name,

Amen.

Our God to Thee we give thanks.

We didn't believe we would see light again.

In your love and in your sunlight we will receive many things.

Be near me as I begin to hoe.

Amen.

Dear Lord God,

Now that I am going to work with my hoe.

Turn away from my garden all prowling evil.

Also give me strength to do my work well.

Amen.

The above prayers have been translated from the vernacular by Mrs. Ruth Engwall, Union Training School, Kimpese, Congo Belge. Reprinted from the Congo News Letter, published by the Missionaries of the American Baptist Foreign Mission Society.

Published by :—The Allahabad Agricultural Institute, Allahabad, U.P. (India.)

THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL

OF

AGRICULTURE AND RURAL LIFE

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Vol. XXII SEPTEMBER, 1948 No. 5

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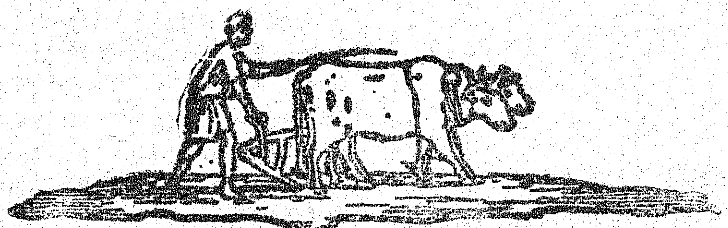

VOL. XXII] SEPTEMBER, 1948 [No. 5

EDITORIAL

PRINCIPAL'S REPORT FOR THE YEAR JULY 1947 TO JULY 1948

[H. S. AZARIAH.]

In the absence of Dr. A. T. Mosher, the duty of preparing this annual report has fallen on me. With deep regret we record the passing away of Dr. J. L. Goheen in the city of New York on the fourth of February, 1948. He came to the Institute in 1945 and won the admiration of all in the short time he was with us. Dr. and Mrs. Goheen flew to the United States on September 18, 1947, on medical advice. His illness was diagnosed as an inoperable cancer. He was cheerful and brave up to the last, and has left an example to all of us. Mr. W. B. Hayes was appointed Offg. Principal and served in that position until Dr. A. T. Mosher was elected Principal in March, 1948. The inaugeration ceremony of Dr. Mosher as third Principal took place on July 21, 1948. Many notable guests were present including Dr. John Mathai, Minister, Government of India, who delivered the inaugural address. Dr. Mosher is now in the United States on a special tour and is expected back before Christmas.

The Allahabad Agricultural Institute which was formerly an unit of Allahabad Christian College is now a separate independent unit under its own Board of Directors. We were happy that Dr. J. L. Dodds the Chairman of the Board of Founders was with us at the first meeting of the new Board of Directors which has taken over the Institute as it had been developed, slowly and often painfully, over the years,

largely through the faith and efforts of Dr. and Mrs. Sam Higginbottom. The Institute is now an inter-denominational institution sponsered by the Methodist Episcopal Church, the Disciples of Christ, the Evangelical and Reformed Church, the Church Missionery Society (England) as well as the Presbyterian Church in the U.S.A. It is hoped that a number of other denominations will share the work of the Institute. Under the new constitution the Institute has a Registrar instead of a Vice-Principal. The appointments of all the administrative officers including the heads of departments are for a period of three years subject to re-appointment. H. S. Azariah was appointed Registrar for the term 1947-50, and Sam John Treasurer.

Mr. and Mrs. W. B. Hayes and Mr. A. P. Brooks left last summer for the U. S. A. on furlough. Dr. and Mrs. E. F. Vestal also left for the U. S. A. to join the staff of the Iowa State College, Ames, U. S. A. We are happy to report that Mr. C. O. Das has secured a Ph. D. from Ohio State College and is now touring Europe. He is expected to join us in the middle of December. Mr. T. A. Koshy also has secured a Ph. D. from the same college. Mr. and Mrs. Koshy will be with us some time in January, 1949, if they can secure passage now.

A large number of alumni are now studying abroad. It is encouraging to get favourable reports regarding their work and character. Last year four young women who took the Intermediate examination in Home Economics here in the Institute went to the United States for further study. We are happy to report that the Board of Directors have sanctioned a sum of rupees twenty five thousand towards the new student-alumni building provided another sum of rupees twenty five thousand is secured by the alumni and students for the building. It is hoped that this will be possible and that the building will eventually be constructed.

Founders Day was celebrated on October 7, 1948, which date is the birthday of Dr. Sam Higginbottom the founder (now retired and in the U. S A.). Dr. Miss Chacko, Principal of Isabella Thoburn College, Lucknow, addressed the students on that day.

We have continued doubling our classes and have admitted two sections to the first year B.Sc. course in Agriculture. Still we can admit only a small proportion of those who apply. In July, 1947 the total student enrolment including women was 282 and in July, 1948, 31 . Examination results for 1947-18 were satisfactory, the number of passes being 42 out

of 67 in the Intermediate in Agriculture with six first divisions; 27 out of 29 in the B.Sc. in Agriculture with four first divisions; 6 out of 8 in Agricultural Fngineering with four first division; 26 out of 27 in the Indian Dairy Diploma course, and 9 out of 10 Intermediate in Home Economics (women).

Dr. (Mrs.) Hayes, the Institute Physician, worked for refugees in Delhi and Ambala for about two weeks during Dasehra 1947.

The religious activities of the Institute have been strengthened by the efforts of our Acting Chaplain the Rev. C. Murray Roggers, who joined us in July, 1947. Since July, 1947, we are having quarter of an hour worship every day before starting regular work in the morning. The programmes as they are being developed enter round the chapel and provide an opportunity to nurture Christian students in their faith and to develop themselves to serve as useful members of their respective churches.

Games and sports are now better organized under the direction of a full-time physical director. The students are also fully cooperating in this. One of our students, V. P. Malvea secured the all-India championship in javelin throw and K. P. Roy the all-India championship for wrestling and was chosen to represent India in the World Olympics in the United Kingdom.

The students' united mess which was started in July, 1946 has continued to function satisfactorily. Meals or served cafetaria-style, and students choose their food according to appetite, taste, and pocketbook. Since July, 1947 Mr. B. R. Aaron has been associate manager and after the departure of Mrs. Vestal for the U. S. A. this summer he took charge as the manager of the mess.

This year (early September, 1948) the Jumna river rose to 164 ft. which was only one foot lower than the flood level in 1876, the highest since that time. It caused severe loss to standing crops and orchards. The estimated loss is about Rs. 1,50,0 0.

Many problems face the Institute as it enlarges its service in the new India. "Our wisdom is not sufficient, and our little courage would be overwhelmed were it not for the sure confidence that He who has brought us thus far on the road, through 'good report and evil', through relative prosperity and great scarcity, will continue to counsel and to provide. We look to God with gratitute and in trust"

REPORT OF THE AGRONOMY DEPARTMENT, 1947-48

By

G. D. SINGH AND S. UPADHAYAYA.

Dr. E. F. Vestal officiated as head of the department in the absence of an Agronomist, taking over the teaching of G.Sc. (Ag.) classes and the direction of research and also acted as Farm Manager from August 1947. Mr. G. D. Singh, continued in the department as part time teacher and part time assistant to the Farm Manager. Mr. N. R. Dey continued in the department and carried a good share of the teaching load. Mr. S. Upadhayaya continued in the department as research assistant and part time teacher. Mr. S. R. Misra continued as an Assistant Farm Manager for the office and general instructor in the farm management. Mr. M. Siddiqui has been in-charge of the farm vegetable section and its marketing.

Research and Experimentation. The department continued the old experiments which were in their 2nd or 3rd year. Some new experiments were also introduced.

Sugarcane.—This was the second year for this experiment. Two varieties Co-393 and Co-453 were involved. The agronomic part of the experiment was to note the effect of using the Top, the Middle and the Bottom portions of the setts on the yield of sugarcane themselves, the cane juice and gur. The superiority of one over the other was also to be tested.

There were only four blocks in the lay-out. In each block there were two sub-blocks and in each sub-block there were 3 plots. There were four experimental lines of each kind of sets in each plot and in one sub-block there was one variety. Taking the two border lines, in all there were fourteen lines from each variety in each sub-block.

Conclusion.—On analysis the yield of Co-453 showed some difference over Co-393. But this year no significant differences were found in yields of sugarcane, cane juice and gur due to selection of sets. The significant difference due to blocks was found very high showing that the area chosen was not worth trying the experiment.

Paddy.—Two experiments were conducted this year for this crop, both varietal. One consisted of eight yearly varie-

ties and the other of four late varieties. These were also on randomized-block layout system.

Results.—Both these experiments failed because (1) the seeds were drilled in the presence of big clods in the field and so when these clods melted after the rains, the rows were mixed up. (2) There was all the time water in the field in the rainy season due to the poor drainage at least in early stage of its growth. So the necessary operations like weeding, which were growing very badly, could not be done.

The only thing that the department thought desirable was to select and harvest the healthy ears of each variety and keep them for next years' seed purpose.

Juar (Grain).—One varietal experiment consisting of eight varieties was tried in a randomized-block lay-out; there bieng 6 blocks, size of each plot was 15′×50′.

One of the variety was Hegari juar, which is an American variety early growing in nature. Therefore, its harvest was done earlier. Another variety was Dukari, which was late-maturing juar. This was harvested later. Other six varieties were harvested at one time. From Dukari, at it was the only variety in the field left for some time, due to certain reasons enough care could not be taken and so there was not any grain harvest but stover.

Results.—On analysis of data of yield of stover it was found that there were significant differences due to blocks and varieties. On further analysis it was found that there was no significant difference between Malwa white, Dodana white, T-9, Hegari, 5-Tall, Dodana yellow and Dukari. But all of these were significantly superior to T-2054 juar (a variety shown on Allahabad Agricultural Institute Farm).

On analysis of grain yield (neglecting that of Dukari as there was no yield for grain) it was found that there was no significant difference among Malwa white, Dodana yellow, T-9, and 5-Tall; but all of these being significantly superior to T-2054 juar, Hegari juar and Dodana white, but there was no significant difference between Dodana white and 5-Tall.

Remarks.—Some of the plots were badly grazed very often by stray animals and so the data was not so reliable.

Juar fodder (Varietal).—The same eight varietis were tried in randomized-block lay-out for fodder. The plot size was 10′×80′.

Results.—After analysing the data of yield it was found that (*i*) there was no significant difference due to varieties (*ii*) that there was very high significant difference due to blocks.

Remarks.—This experiment also shows the wrong choice of the site of the experiment.

Juar fodder (*Agronomic*).—This was the third and concluding year for this experiment. The laying out was similar as in previous years.

Results.—This year there was not found any difference (significance) in broadcasting and keeping 2' distance row to row. But both of these were found to give slightly greater yields than 2½' spacing in this particular test.

Finally we can conclude that for fodder purpose the most suitable method of showing is by broadcasting.

RABI SEASON.

Wheat Varietal.—Seven varieties namely C-13, X-9, X-7, X-1, I.P.-4, I.P.-52 and local selected were tried in the randomized-block lay-out. The plots were 8'×60'.

Results.—On analysing the data there was found very high significant difference due to blocks and varieties. Finally we can sum up our conclusion as follows :—

Varieties :—	C-13,	X-7,	X-9,	X-1,	I.P.-52,	I.P.-4,	L.S.,	Significant difference
Grain yields (in seers).	44	30·5	27·5	26	25	25	21·5	4·88

Bhusa yield data analysis.

Varieties	X-1,	X-7,	C-13	I.P.-52	L S.	X-9	I.P.4	Significant difference
Bhusa yield (in seers)	82·5	76·5	67·5	66	65·5	65·5	48	10·7

this means that in yielding bhusa X-1, and X-7 are significantly superior to others. I.P. 4 being poorest.

Wheat-Manurial.—There were 6 treatments tried in a randomized-block lay-out :—

A.—F.Y.M. 40 lbs. N. per acre
B.—$(NH_4)_2 SO_4$ 40 lbs. N. per acre
C.—$(NH_4)_3 PO_4$ 11 lbs. N and PO_4 per acre
D.—Check
E.—F.Y.M.—$(NH_4)_3 PO_4$ 116 lbs. F.Y. manure; 4 lbs. PO_4 per plot.
F.—F.Y.M. 80 lbs. N. per acre.

Results.—After analysing the yield data the results were found as.—

Treatments	C	F	B	D	E	A	Significant difference
Grain yield in srs.	32	31·5	29	28	28	26	No
Treatments	C	F	E	B	A	D	
Bhusa yield	77	74	71	70	67	65·5	8·8

The variety tried was I.P.-52.

Oats.—Primarily the experiment was stated with intention of fodder from the first cutting and grain from the second cutting but as irrigation facilities were not proper, the idea was changed and only one harvesting was done when the grains matured.

The experiment was conducted in a randomized-block layout, the plot size 60′×8′. There were seven varieties.

On analysis the results did not show any significant difference either due to blocks or varieties. The varieties tried were (1) C. I.=3693, (2) C. I.=2820, (3) C. I.=1027, (4) C. I.=2054, (5) I. P.=3531 (6), I. P.=2 and (7) Local.

Earley Potato.—The previous year experiment was repeated. The potato seeds were treated with spergon and then in alternate rows treated and untreated seeds were sown. The yield data was analysed. The results this year were found just the opposite; the untreated giving higher yield, which, of course, was not found significant.

Another experiment was on spacing, *i.e.*, the distance between seeds to seeds. Three distances were tried; 4″, 6″ and 8″. For each spacing there were four rows, in all making 12 rows for the experiment on analysis the yield data for the 4″ spacing was found significantly superior to 6″ and 8″. This was the first year for this trial.

Late Potato.—The seed treatment by spergon was tried again this year for late potato also. Results were found similar to that of early potato trial; the yield of untreated being higher but it was not significant.

Weed-killer trials.—The department was in possession of some weed killing compounds. Stantox and Sinox were liquid compounds which we got from U.S.A., for trial here. Stantox is called 2.4.D also. It is a hormonic concentrated solution. Sinox is a chemical compound, the details are not known. We had with us one powdery compound Methoxone

and we tried all of these. Trials were made during both the seasons and in crop fields, in lawns and the places where there were only weeds. Of course, due to certain reasons no data could be collected so as to analyse and find out the significant results, but from our trials we have made the following conclusions :—

(1) That these weed killer's cannot kill the grass family weeds like doob or lawn grass (Cyno dactylon). Sidaspinosa, Pennisetum cenchroides and most of other grass family common weeds. (2) That these were not effective on other family plants also like Achyranthus aspera, Tridex procumbens, Madar plant, Peristrophebicalyculata, Tribulus terrestries, etc. (3) That Stantox was worst effecting in hot weather and Sinox in winter. The methoxone's effects were not so remarkable. (4) That concentrated solutions were more effective. (5) That dry, hot and calm weather is more desirable. (6) That the leguminous plants were affected very badly and in most cases immediately. (7) That broad leaved plants were more affected. (8) The cereals were not affected under concentrated conditions. (9) Asphodelus tenuifoleus, Alhagi species plants among winter weeds were affected by only highly concentrated solutions. Cheemapodium species, Amaranthus species, Lauina asplenifolia were easily killed. Other thorny weeds from Compositate family were not so much affected. (10) The weeds are easily killed when young and so most of these which have been mentioned above unaffected, if short rooted can be killed in young stage and (11) Short-root plants are killed easily.

On the whole the conclusion that can be made for the present that these weed-killers can be applied in lawns where we need only doob, (Cynoden dactylon) which is least affected.

Our future trails will show how far it will be economical to apply these weed killers in comparison to weeding.

Under American conditions these have shown quite satisfactory results, especially 2.4.D. (Stantox).

'THE FARM'

(G. D. Singh.)

The summer 1947 was hot and rainless, the meteorolocial observatory at the Allahabad Agricultural Institute, recorded

113° F the highest temperature on the first of June, 1947. All the fields had at least one dry weather ploughing. As there were light showers in January, February and March the soil was not very hard and the ploughing was mostly done by 8 inches soil turning ploughs, with single pairs. Some of the fields badly infested with Kans kush were ploughed twice before the break of the monsoon.

The change in the weather became noticeable from the second week of June, 1947. Rains of 0·35 and 0·09 inches were received respectively on the 10th and 11th June, again a light shower of 0·37 inches on the 18th June but the actual monsoon started from June 29th a week later than the normal time. The first monsoon rain was 1·55 inches and it was enough to start the sowing of Kharif (monsoon) crops. The occasional light showers continued for a week. Seeding operation started according to the schedule and most of the Kharif planting was covered within twelve days. The germination of all the Kharif crops was excellent. The rain fall was normal in the months of July and August but September 23rd was practically the end of the regular monsoon. This year again the Yamuna river rose for four times in the rainy season, the highest level reaching 159·3″ inches on the 12th September, 1947. There was a considerable loss of the standing fodder crop especially Napier and Juar crops, yet the net results of the Kharif crops were much better than last year. The total rain-fall in the year was 36·02 inches, only 3·0 inches less than the average rain fall for Allahabad. The harvesting of main fodder crop (juar) started in time but due to shortage of labour the harvesting did not finish in time. Some of the fodder Juar which could not be harvested in time was left for seed.

The monsoon weakened in the month of September, it resulted in poor preparation of rabi (winter) seed bed. The Kachar land (river bank) after the flood was ploughed with a tractor plough (mould-board). The moisture was considerably lost from this area. All over the farm the germination of rabi crops was very poor. Many of the fields were left unplanted. From October 3 to January 3, there was no rain. In January there were five drizzlings, and it amounted to 0·85 inches only. These light showers were not of much help to the winter crops. On the whole the rabi season agriculturally was unfavourable than last year. The following table gives the results of crops on the Institute Farm for the year 1947-48.

Table giving the results of Crops grown on the Allahabad Agricultural Institute Farm during the year, 1947-48.

Crops	Area in acres	Total yield		Total Cost Rs.	Tootl Income Rs.	Surplus or deficit Rs.
		Fodder *Mds.	Grains Mds.			
Lucerne (B) 46/47	6·10	2,063	..	2,191	2,771	+580
Summer fodder (A)	6·61	2,400	7	1,246	2,450	+1,204
Grasses and Sarpat	..	16,948	..	5,914	7,209	+1,695
Napier grass ..	22·15	38,380	..	8,626	24,726	+16,00
Guinea grass ..	2·40	2,672	..	1,165	1,548	+383
Vegetables ..	17·90	1,66[illegible] (B)	..	5,742	6,231	+489
Juar fodder etc. ..	139·10	38,083	636	17,307	37,615	+20,308
Cowpeas ..	22·70	2,401	31	3,941	3,661	—280
Maize	9·00	1,548	95(C)	1,580	3,167	+1,587
Sann-hemp ..	26·10	744	172	2,253	1,794	—459
Miscellaneous crops (D).	2·60	801	..	1,646	1,243	—403
Arhar	5·00	80	36	1,128	628	—500
Bajra	1·00	360	11	249	400	—151
Guara	1·50	..	2	98	21	—77
Wheat	88·60	1,960	500	10,014	13,362	+3,348
Berra, barley etc. ..	42·92	226	190	3,771	2,487	—1,284
Early Potatoes ..	10·70	972	..	4,582	5,610	+1,028
Hill Potatoes ..	2·70	98	..	1,360	703	—657
Berseem ..	2·80	1,253	..	968	1,974	+906
Winter fodder (E) ..	8·50	7,680	..	10,897	2,688	+8,209
Sugarcane ..	2·40	250	..	3,300	1,083	—2,217
Lucerne 47/48 complete by May 1948.	6·00	1,068	..	1,036	1,724	+688
Totals ..	..	..	..	89,014	1,23,095	50,497

*Fodder include—straw and the quantity for early and hill potatoes etc.

(A) Summer Fodder include—Bajra, Sawan, Cowpeas, and Maize.

(B) The quantity stated above includes, Cabbage, Cauliflower, Lettuce, Radish and Turnip etc. the weight of which has been estimated but their cost and income are included in the figures above.

(C) We sold 40,536 green maize ears and 95 maunds seed received and the weight of green ears is not included in the above quantity.

(D) Miscellaneous Crops include—Ground nut, Sweet potatoes, Sunflower, Beans, Soybeans and Kudzu vines.

(E) Winter Fodder include—Bajra, Maize, Radish, Sunflower and Oats etc.

The crop results this year show better surplus than last year. All the fodder crops show a handsome surplus except Cowpea, which was partially flooded in the growing season. The other crops which have shown deficit are Sun-hemp, Miscellaneous Crops (D), Guara, Berra, Hill Potatoes and Sugarcane. The losses in the above crops are marginal except the Sugarcane crop. The chewing cane was purchased from the local market. The germination of this seed cane was very poor and ultimately resulted into very heavy deficit on a very small acrage. Some of the crops which have shown very high surplus are Juar, Napier, wheat and Winter fodders.

This year again a new Combine Harvester and Thresher (Self-propelled) machine was used to harvest most of the wheat area. Few acres of barley crop was also harvested with this machine. The operation costs of this machine are with the Engineering Department, but very safely this much I can say that this machine has been a boon to the farm, specially in the rabi harvesting period when the labour was scarce and costly. The straw this year was handled directly from the machine in detachable carts without much loss in the fields like previous year. On the whole the combine harvesting and threshing machine has been more economical than hand harvesting and threshing of previous years.

The position regarding labour was as follows :—

—	Total man-days	Total cost in Rs.
Permanent labour	18,955	21,061
Temporary labour	17,390	13,253
Total ..	36,345	34,314

The total number of man days in 1946-47 was 44,617 and this year 36,345. In spite of the same urgency and increased wages we could not get the required number of labourers for the farm work. This clearly shows the growing scarcity of farm labour. With the present labour situation we have to modify our farming scheme and practices, such a way, that we could easily eliminate those crops which require plenty of hand labour, secondly to use suitable improved implements to cover more area per man, thirdly to use some of the most suitable machines like combine harvester and thresher and corn harvester to cover large areas with minimum number of man days in shorter periods.

REPORT OF AGRICULTURAL ENGINEERING DEPARTMENT, 1947-48.

Staff.—Mr. M. Vaugh, Mr. K. P. Misra, Mr. R. N. Pahalwan and Mr. C. M. Jacob continued as members of the teaching staff. Mr. Moraes of the teaching staff was transferred to the implement research section. Mr. J. S. Bali joined in July, 1947 as lecturer in Physics and Mathematics. Mr. C. V. Paul returned to the department after a period of 5 years and took charge of the workshop and advanced shop classes. Unlike the previous year there was no change in teaching staff during the academic year of 1947-48. We hope this will continue to be so in future, thereby steadying and strengthening the teaching side of the department.

There have been a number of changes in the research staff. Mr. B. D. Sharma resigned as implements research engineer and was succeeded by Mr. E. J. W. Moraes. Mr. M. L. Toneja and Mr. A. P. Srivastava served varying periods in connection with bullock scheme.

Teaching.—This year there has been a great rush of students seeking admission in B.Sc. (Agril. Eng.) Course in contrast to the previous year. To some extent this must have been due to the fact that Ag. Engineers from here have got fine jobs in the Government and elsewhere. But undoubtedly this was due to the general realisation of the need in the country for training in Agricultural Engineering. It might be worth mentioning here that ours is the only institution in India which gives specialised training for Agricultural Engineering. Of the eight students who appeared in the final examination this year six have passed and all the six are suitably employed now.

Manufacture of Implements.—The manufacture and sale of implements continued to be hampered by various factors during the year under report. Delay in the arrival of machines shortage of supply of materials and especially unsatisfactory shipping facilities all contributed in making it impossible to meet the increasing demands for the implements manufactured at the Institute. Yet it is gratifying to note, from the many orders that come, the growing appreciation felt by farmers about the implements. No new item was added to the list of implements being offered for sale.

Rainfed Farm.—Mr. V. C. Watford continued to be in charge of the experimental farm as manager until Mr. Moreas took over charge on June 8, 1948. Some portions of the farm

were affected by the unusual flood which rose as high as within a foot of the record flood of 1916. This upset very badly the cropping scheme and so the research scheme.

Work on the "hegari" sorghum was continued. It was planted under different conditions and the results were observed. Research was carried out with Napier grass and kudzu vine. Preliminary trials of interculture of juar sown in lines to control weeds were not entirely successful. Further trials with increased supervision are being planned for the coming year. A number of experiments were carried out with the different implements manufactured at the Institute like U. P. No. 1 plough, the Shabash cultivator, etc. Experiments on green manuring, use of sweeps for late Rabi preparation were continued. During the year a new Massey Harris Clipper Combine, self propelled type, was received and used in the Rabi harvest. During its operations a new devise, which worked quite satisfactorily, was attached to the machine to save the straw.

During the year four new projects were taken in hand:

1. simple mechanisation of the harvest of fodder crops,

2. a simple potato planter,

3. a winnower for rabi crops, rice juar and bajra, etc.

4. a seed dropping mechanisation for use with seeding spouts on cultivators.

Bullock Research Scheme.—Inspite of the changes in staff as indicated elsewhere, the sanctioned period of the bullock research scheme was completed as far as field observations were concerned. The results are being analysed and finalised at present. A part-time employer of the department Mr. K. Kanungo was sent to I.C.A.R., Delhi for training for a fortnight in connection with this.

Building Work.—Building work in the department was hampered by unsatisfactory supply of steel and cement. The supply of bricks, which used to be unsatisfactory previously, improved towards the end of 1947, so much so, that now the problem might be considered as solved for the time being. The basement dining hall attached to Men's Hostel No. 2 would have been complete by now had there been regular supply of necessary materials. During the year four bachelor staff quarters and one family staff quarter have been completed.

U.N. F.A.O. : Survey Work.—During the year under report a most interesting and valuable work was carried out by the department. On the request of the United Nations Food and Agriculture organisation Mr. Vaugh, through the department, carried out a survey of agricultural implements used in certain villages of U. P. Mr. C. S. Iyer Mr. U. S. Lal, Mr. Kailash Chandra, Mr. V. S. Saxena joined the staff to assist Mr. Vaugh with this survey. The survey was successfully completed during the year and the report has been submitted to the U.N.O.

REPORT ON THE DEPARTMENT OF ANIMAL HUSBANDRY AND DAIRYING, 1947-48.

[JAMES N. WARNER, M.Sc.]

Personnel :

Dr. T. W. Millen	... Professor of Animal Husbandry and Dairying; Department Head; (on leave).
Mr. J. N. Warner	... Professor of Dairying; Officiating Department Head; Milk and Milk Products.
Dr. A. W. McClurkin	... Professor of Animal Husbandry; Veterinary Science and Animal Genetics.
Mr. I. N. Mathur	... Lecturer in Animal Husbandry; General Supervisor of Cattle Yard Operations; Animal Nutrition.
Mr. T. V. Rama Iyer	... Lecturer in Dairying; Acting Dairy Manager from April to January; Milk and Milk Products.
Mr. P. K. Bhargava	... Lecturer in Animal Husbandry; (on leave).
Mr. R. P. Arora	.. Assistant in Animal Husbandry and Dairying.
Mr. O. B. Tandon	... Assistant in Animal Husbandry.
Mr. P. S. Indapurkar	... Assistant in Animal Husbandry.
Mr. K. Das Gupta	... Creamery Supervisor, from April to January.
Mr. D. Sundaresan	... Assistant in Dairying; Acting Dairy Manager, February to March.
Mr. L. P. Srivastava	.. Research Assistant.

Mr. I. N. Mathur was appointed General Supervisor of Cattle Yard Operations in April to succeed Mr. S. S. Bhatia, resigned. Mr. T. V. Rama Iyer left the department the end of January to become Deputy Director of Veterinary Services, Central Provinces, officer in charge of the Ghee Scheme. Mr. K. Das Gupta left the department the end of January to become Dairy Expert with the Calcutta Co-operative Milk Supply

Union. Mr. D. Sundaresan joined the department early in February coming from the post of Manager, College Dairy, Nagpur. Mr. L. P. Srivastava joined the department the latter part of May to take charge of a special research study being made on Quality Improvement in Milk and Milk Products and its Costing, financed by the Indian Council of Agricultural Research.

MILK AND MILK PRODUCTS

The demand continues high for milk and milk products from the Institute Dairy. With our limited production we are unable fully to supply that demand. Since we handle only the milk products in our own herd, we are especially unable to keep up our supply to regular customers when our own production diminishes. During this year it was necessary to restrict the supply from June through October because of the comparatively low production in our herd. This situation improved somewhat after November.

The sales of milk and milk products by months during the year are shown in Table I. The totals of the previous year, 1946-47, are included for comparison.

TABLE I

Sale of milk and milk products, 1947-48.

(Figures in pounds)

Month	Whole milk	Butter	Skim milk	Dahi	Cream cheese	Cream	Ghee	Ice cream	Chedda cheese	Daily average of whole milk
April	42,370·5	1592·1	5664·5	1151·0	..	67·5	..	2256·9	115·8	1412·3
May	39,880·0	1091·2	6664·9	1462·0	..	43·1	..	1854·8	56·5	1283·2
June	35,152·5	559·9	2247·2	1400·5	..	22·5	..	1078·2	135·8	1171·8
July	33,873·5	543·0	2111·5	871·5	..	20·1	..	866·8	132·9	1092·7
August	31,821·5	821·6	1160·9	318·5	..	9·2	..	436·9	128·4	1026·4
September	31,015·5	1185·8	969·8	298·5	..	12·6	4·4	550·8	39·6	1033·8
October	31,372·0	1346·1	2174·0	314·0	..	26·1	21·0	457·8	158·8	1012·0
November	26,686·0	1061·9	631·8	194·0	..	29·0	..	150·8	128·1	889·5
December	27,213·5	1347·6	3746·5	191·5	..	32·4	..	..	153·8	877·8
January	28,349·0	1220·8	4552·9	104·0	..	44·9	7·4	..	34.5	914·4
February	31,000·5	1223·2	3371·5	173·5	2·6	60·8	11,8	25·5	58·6	1068·9
March	32,467·5	1331·5	4916·5	521·5	..	51·1	5·3	1015·8	116·8	1047·3
Totals ..	3,91,202·0	13,324·8	38,211·9	7000·5	2·6	419·5	49·8	8694·0	1259·4	1071·8
Previous year totals ..	3,87,374·0	16,195·4	97,645·5	5832·0	..	943·5	106·9	8032·0	2834·4	1061·3

Milk sales increased again this year, although only 3828 pounds, compared with an increase of 69,604 pounds a year earlier. Daily sales of fluid milk were highest in April and May, lowest in November and December. This unusual pattern of sales resulted from a greatly diminished supply of milk in the winter months. We received 4,70,160·2 pounds of milk from the Cattle Yard during the year.

Only 43,405 pounds of milk were separated this year, compared to 97,939 pounds last year. In addition to the cream produced thereby, *viz.*, 2876·8 pounds, the cattle yard supplied 759·3 pounds. These two lots of cream were used mainly for fluid cream and ice cream purposes, only small quantities being made into butter.

Apart from a small portion of the home cream which was used, 20,217 pounds of cream were purchased for butter making. The price of this cream varied from Rs. 1-14-0 to Rs. 2-3-0 per pound of butter out turn. The United Mess in the Men's Hostel at the Institute used a large part of the 39,736·8 pounds of skim milk which was produced, for making skim milk *dahi.* The remainder was sold for human consumption elsewhere or fed to pigs and chickens. All buttermilk was fed to pigs and chickens.

Dahi sales increased nearly 20 per cent. this year over last year.

No butter was exported from Allahabad this year. If cream were available in adequate quantities, considerable butter could be sold in Calcutta, as in former years. The supply of cream was particularly short this year in June, July and August. For this reason butter sales this year were nearly 2871 pounds less than last.

The market for ice cream continues good. The shortage of milk and cream this year was greatly aggravated by the shortage of sugar early in the year and of salt later. Despite these problems, our ice cream sales increased about 8 per cent. Sales were greatest in April, May and June, 1947 and March 1948. As in previous years, most of our ice cream was sold to private customers purchasing from five to twenty pounds at one time.

This year several new cycle units were purchased or constructed to improve our delivery equipment. The old Alfa cycles, used for many years, have become irrepairable. The new units are of three types; one is a manufacturers' model; two, our own design.

The two units we designed were constructed by the Department of Agricultural Engineering, according to our specifications. Each of these units consists of an ordinary bicycle to which a carrier attachment is fixed. One of these attachments is a two-wheeled trailer; the other, a single-wheeled sidecar. Each consists of a platform with an open, welded iron frame about its four sides extending 18 to 20 inches above it. The trailer platform is mounted between two ordinary bicycle wheels and is provided with a handle or bar by which it is attached to the bicycle frame just below the seat and above the rear wheel. The attachment consists of a ball and socket joint which permits complete freedom of movement of the cycle while in operation. The side car platform is mounted on an axle, to the right end of which is attached an ordinary bicycle wheel. The left end of this axle is fixed to the rear wheel axle of the bicycle by means of an inverted U-shaped bar, the ends of which are attached to either end of this axle. The two front corners of the platform are each attached to the front part of the cycle frame, the left corner to the lower frame bar just behind the fork, and the right, or outside, corner, by means of a looped bar, to give a spring effect, to the upper frame bar immediately behind the fork. Space is allowed between the inside edge of this side car platform and the cycle to permit unimpaired pedal action. The side car if attached to the right hand side of the cycle.

Both of these units are proving very satisfactory because they are light, compact and maneuverable, while loaded. The salesmen, after learning to handle it, prefer the side car to any of the other units now in use.

Methods by which to prevent tampering with the milk by persons handling it, particularly between the Dairy and the customer or his agent, are urgently needed in this country. The Institute continuously seeks such methods. This year, in addition to sealing the milk delivery cans shut when issuing milk for the routes, the can were fixed rigidly to the delivery cycle and sealed in position. This prevents the removal of the can from the cycle and its inversion, both of which are sometimes necessary to tampering with their contents. Fixing and sealing the delivery cans to the cycle has helped to reduce the adulteration of milk during delivery.

The products sold in the Milk Bar, opened last year, are shown in Table II. These quantities are included in the figures in Table I, as the latter figures are totals for the Institute Dairy.

TABLE II.

Sale of milk and milk products at the Milk Bar, 1947-48.
(Figures in pounds)

Bulk milk	Bottled milk	Butter	*Dahi*	Cream	Ice cream	Cheddar cheese	Chocolate milk
47,834·0	12,424·0	2,959·1	8,311·5	17·9	2,174·5	59·8	229 0

MILK STOCK

The number of heads of milk stock, Table III, diminished from 193 to 172 during the year. While the number transferred to milk stock, at the time of their first parturition, decreased from 48 in the previous year to 39 this year, the number sold increased from 32 to 57. Both these factors contributed to the decrease in milk stock. The largest changes occurred in the Red Sindhi and Murrah groups. As the intensity of selection is increased, in order to maintain a constant number in the herd, the groups containing the poorest producers would experience the severest selection. While both our Red Sindhi and Murrah cows produce rather well for their respective breeds, they are among the lowest producers, on an average, in our herd. Others which showed a reduction in numbers during the year were the 1/8 Holstein-Sindhi and the 1/8 Brown Swiss-Sindhi groups. There were only three deaths in the milk stock animals during the year; that is less than 1·5 per cent. A profit of Rs. 8,600 was realised over their inventory value on those sold.

TABLE III.

Milk stock statistics, 1947-48.

Serial Number	Breed	Number on 1st April, 1947	Transferred from female young stock	Sold	Died	Number on 31st March, 1948
1	Red Sindhi	52	16	..	1	41
2	1/8 Jersey-Sindhi ..	8	3	6	1	12
3	1/4 Jersey-Sindhi ..	32	5	5	..	32
4	1/2 Jersey-Sindhi ..	16	..	1	..	15
5	9/16 Jersey-Sindhi ..	..	1	..	..	1
6	5/8 Jersey-Sindhi ..	..	2	..	..	2
7	Jersey	2	..	..	..	2
8	1/8 Holstein-Sindhi ..	7	1	5	..	3

Serial Number	Breed	Number on 1st April, 1947	Transferred from female young stock	Sold	Died	Number on 31st March, 1948
9	1/8 Brown Swiss-Sindhi ..	11	3	6	..	8
10	1/4 Brown Swiss-Sindhi	6	1	..	..	7
11	1/4 Miscellaneous-Sindhi	8	..	1	..	7
12	1/2 Miscellaneous-Sindhi	5	1	2	..	4
13	Miscellaneous ..	15	5	3	..	17
14	Murrah (buffalo) ..	31	6	15	1	21
	Totals ..	193	39	57	3	172
	Previous year totals ..	184	48	32	7	193

The average production, among other data, of those lactations completed, during 1947-48 is shown in Table IV. Of the 133 lactations completed, 49 were those of heifers. Since heifers have no dry period preceeding those of their lactations included here, their production was not taken into account in calculating either the days dry or the daily overall average for each group or for the whole herd. The production of these animals was included, however, in determining the average yield, the average days in milk, and the daily milking average days in milk, and the daily milking average in each case.

The herd produced 4,91,391·8 pounds of milk during the year under report, or an average of 1,346·3 pounds a day. Of this, 4,70,160·2 pounds were transferred to the Dairy and 21,231·6 pounds were fed to calves as whole or skim milk. Any cream produced by separating milk for the calves was also transferred to the Dairy.

No improvement over 1946-47 was shown in the performance of the Jersey and the 1/4 Miscellaneous Sindhi groups. The greatest improvement was shown by the 1/8 Brown Swiss-Sindhi and the Murrah groups, with reasonable improvement being shown by the 1/8 Holstein-Sindhi and 1/4 Brown Swiss-Sindhi groups. Of these, however, the Murrah group is the only one involving a large number of animals, hence the only one whose results may be significant.

Those groups of cows showing the greatest improvement this year, as compared to 1946-47, in the respective measures of performance included in the table, were the smallest groups. Of the three large groups, the greatest improvement was

shown by the Murrah cows in average yield (91·4 lbs. more), the daily milking average (1·15 lb. more), and the daily overall average (2·00 lbs. more); by the ¼ Jarsey-Sindhi cows in milk (44·4 days nearer an ideal of 300); and by the Red Sindhi cows in days dry proceeding the lactation (45·2 days nearer an ideal of 65 days).

TABLE IV.

Lactations completed during, 1947-48.

Serial number	Breed	Number of lactations completed	Average yield (in pounds).	Average days in milk.	Average days dry preceding the lactation.	Daily milking average.	Daily overall average.	Number of heifers.
1	Red Sindhi	33	3149·1	312·7	166·3	10 07	6 67	9
2	1/16 Jersey-Sindhi ..	2	3990·6	370·0	48·0	10 79	10·16	1
3	1/8 Jersey-Sindhi ..	4	5137·4	502·8	147·0	10·22	9,50	3
4	1/4 Jersey-Sindhi ..	28	4166 9	353·2	73·5	11·80	9,80	4
5	1/2 Jersey-Sindhi ..	8	4251·2	378 6	90·6	11·23	9,08	1
6	Jersey	3	1200·4	246·3	22·5	4·87	4,59	1
7	1/8 Holstein-Sindhi ..	5	3429·0	285·6	91·0	12·01	10·33	2
8	1/8 Brown Swiss-Sindhi	7	3298·1	357·3	208 0	9·23	5·93	6
9	1/4 Brown Swiss-Sindhi	4	5307·0	398·2	99·5	13,33	10·92	2
10	1/4 Miscellaneous-Sindhi	4	4759·7	388·0	67·0	12·27	10·80	2
11	1/2 Miscellaneous-Sindhi	3	5621·5	384·0	65·0	14·64	13·12	1
12	Miscellaneous ..	7	5432 0	4 7·7	69·2	12·13	9·99	3
13	Murrah (buffalo) ..	25	3580·1	349·9	143·8	10·55	8·30	14
	Weighted average for herd.	133	3846 8	352·2	112·3	10·97	8·69	49

Table V gives the average age and weight of first calving for the different groups of heifers which calved during the year. Compared with the previous year, there was no change in the age at first calving in the herd as a whole, though there were changes, not fully shown here, in certain groups. The weight at the time of calving of the heifers this year was nearly 80 lbs. below that of a year earlier.

TABLE V.

The average age and weight at first calving of 30 heifers transferred to Milk stock during the year, 1947-48.

Serial number	Breed	Number of animals.	Average age in years.	Average weight in pounds.
1	Red Sindhi	6	3·91	638·3
2	1/8 Jersey-Sindhi	8	3·55	629·4
3	1/4 Jersey-Sindhi	5	2·80	548·0
4	9/16 Jersey-Sindhi	1	3·00	640·0
5	5/8 Jersey-Sindhi	2	2·30	502·5
6	1/16 Holstein-Sindhi	1	2·25	580·0
7	1/8 Holstein-Sindhi	1	3·50	690·0
8	1/16 Brown Swiss-Sindhi ..	1	3·75	660·0
9	1/8 Brown Swiss-Sindhi	3	2·66	636·6
10	1/4 Brown Swiss-Sindhi	1	2·50	530·0
11	1/8 Miscellaneous-Sindhi	3	3·88	615·0
12	1/2 Miscellaneous-Sindhi	1	3·63	790·0
13	Murrah (buffallo)	6	5·85	1058·0
	Total herd ..	39	3·69	682·1
	Previous year total herd ..	48	3·68	762·9

FEMALE YOUNG STOCK.

Table VI shows the number of female young stock in the herd at the beginning of and at the end of, as well as the numbers born, transferred, sold and died during the year. Over 80 per cent. of the zebu and crossbred heifers on hand at the end of the year contained 3/4ths or more Red Sindhi ancestry.

Our market for Red Sindhi stock improved this year, following the separation of the home tract of this breed, namely Sind, along with other areas, from what is now the Dominion of India. The sales of Red Sindhi heifers, young bulls, and cows, consequently increased, enabling rather intensive selection in the Institute Red Sindhi herd.

TABLE VI.

Female Young Stock, 1947-48.

Serial number.	Breed.	Number on 1st April, 1947.	Born during the year.	Transferred to milk stock.	Sold.	Died.	Number on 31st March, 1948.
1	Red Sindhi	34	22	6	8	11	31
2	1/16 Jersey-Sindhi ..	..	2	..	..	1	1
3	1/8 Jersey-Sindhi ..	28	8	8	2	2	24
4	1/4 Jersey-Sindhi ..	9	4	5	..	3	5
5	5/16 Jersey-Sindhi ..	..	1	..	..	..	1
6	1/2 Jersey-Sindhi ..	..	1	..	..	1	..
7	9/16 Jersey-Sindhi ..	3	2	1	..	..	4
8	5/8 Jersey-Sindhi ..	5	2	2	..	..	5
9	3/4 Jersey-Sindhi ..	5	..	..	..	..	5
10	Jersey ..	1	..	..	..	..	1
11	1/8 Holstein-Sindhi ..	3	..	1	..	..	2
12	1/8 Brown Swiss-Sindhi ..	6	1	3	..	..	4
13	1/4 Brown Swiss-Sindhi ..	2	1	1	..	..	2
14	1/8 Guernsey-Sindhi ..	1	..	..	..	..	1
15	1/32 Miscellaneous-Sindhi ..	4	..	..	..	..	4
16	1/16 Miscellaneous-Sindhi ..	16	5	2	..	1	18
17	1/8 Miscellaneous-Sindhi ..	10	..	3	..	..	7
18	1/4 Miscellaneous-Sindhi	2	1	..	..	..	3
19	1/2 Miscellaneous-Sindhi ..	2	..	1	..	..	1
20	Miscellaneous	4	3	..	2	..	5
21	Murrah (buffalo) ..	23	11	6	..	2	26
	Totals ..	158	64	39	12	21	150
	Previous year totals ..	173	76	48	6	38	157

MALE YOUNG STOCK.

A very much larger number of male young stock was sold this year than last, Table VII. This was the result of a definite policy of selling most of these animals as quickly as possible after birth, rather than raising them as was done previously. For this reason the number dropped from 51 at the beginning of the year to only 7 at the end of the year. The expense of rearing these animals is so high that only if they are sold for breeding purposes at good prices can their cost possibly be recovered. Selling them as bullocks

will never return the cost of rearing them under our conditions. It is imperative, for this reason, that these animals be held no longer than is absolutely necessary. Increasing numbers of them are being sold at one or two days of age for a few rupees.

TABLE VII.

Male Young Stock, 1947-48.

Serial number.	Breed.	Number on 1st April, 1947.	Born during the year.	Sold	Died.	Number on 31st March, 1948.
1	Red Sindhi	14	12	17	7	2
2	1/8 Jersey-Sindhi ..	8	11	16	3	..
3	1/4 Jersey-Sindhi ..	2	5	4	3	..
4	1/2 Jersey-Sindhi ..	1	3	1	3	..
5	5/8 Jersey-Sindhi ..	1	1	1	1	..
6	3/4 Jersey-Sindhi ..	..	1	1	..	..
7	Jersey	1	..	..	1	..
8	1/8 Holstein Sindhi ..	..	1	1	..	..
9	1/8 Brown Swiss-Sindhi ..	2	3	5	..	..
10	1/4 Brown Swiss-Sindhi ..	1	..	1	..	..
11	1/32 Miscellaneous-Sindhi ..	3	5	6	2	..
12	1/16 Miscellaneous-Sindhi ..	3	13	13	3	..
13	1/8 Miscellaneous-Sindhi ..	2	1	3	..	..
14	1/4 Miscellaneous-Sindhi ..	1	2	2	1	..
15	Miscellaneous	3	4	4	1	2
16	Murrah (buffalo)	9	11	10	7	3
	Totals ..	51	73	85	32	7
	Previous year totals ..	57	78	46	30	51

The number of services performed in the Institute herd by artificial insemination during 1947-48 was only 11, as shown in Table VIII. This number is much smaller than in previous years because of the absence of both Dr. T. W. Millen and Mr. S. S. Bhatia who handled this work in the department.

TABLE VIII.

Artificial insemination statistics, 1947-48.

—	Institute zebu and crossbred cows	Institute buffaloes	Outside cows	Total
Direct Services	204	10	153	367
Artificial services ..	11	..	..	11
Totals ..	215	10	153	378
Artificial services as % of total.	5·1	0·0	0·0	2·9

SHEEP

The number of sheep diminished from 96 to 74, Table IX. Apart from the four heads which were butchered, the large number of deaths was the primary cause of this reduction.

TABLE IX.

Sheep Statistics, 1947-48.

Sex	Number on 1st April, 1947	Born	Sold	Died	Butchered	Number on 31st March, 1948
Male	23	14	..	11	4	22
Female	73	18	..	39	..	52
Totals ..	96	32	..	50	4	74
Previous year totals ..	94	48	6	39	1	96

GOATS

The number of Jumna Pari goats decreased, Table X, while there was a slight increase in the number in the Bar Bari flock, Table XI. The number of kids born to a female at one time, under conditions prevailing at the Institute, differs noticably between these two breeds. Whereas the 23 mature

Jumna Pari females, on hand at the beginning of the year, produced 24 kids, or an average of one kid each, the 11 mature Bar Bari females produced 22 kids, or an average of two kids each. In 1946-47 the numbers of kids per mature female of these two breeds were 0·77 for the Jumna Pari and 1·5 for the Bar Bari. The present year showed an improvement in both cases.

TABLE X.

Jumna Pari goats statistics, 1947-48.

Sex	Number on 1st April, 1947	Purchased	Born	Sold	Butchered	Died	Number on 31st March, 1948
Male ..	13	..	11	..	1	18	5
Female ..	23	..	13	..	1	13	22
Totals ..	36	..	24	..	2	31	27
Previous year totals.	37	1	20	..	..	22	36

TABLE XI.

Bar Bari goats statistics, 1947-48.

Sex	Number on 1st April, 1947	Purchased	Born	Sold	Butchered	Died	Number on 31st March, 1948
Male ..	8	..	13	..	..	9	12
Female ..	11	..	9	..	..	9	11
Totals ..	19	..	22	..	..	18	23
Previous year totals.	12	6	12	1	2	8	19

POULTRY.

The number of poultry diminished from 411 to 203 during the year, Table XII. The largest reductions occurred in the White Leghorns, Ducks, Chickens and Ducklings groups. Both birds and eggs continue to be sold for hatching and for eating purposes.

TABLE XII.

Poultry Statistics, 1947-48.

—	White Leghorns Fm.	M.	Rhode Island Reds Fm.	M.	Silkies Fm.	M.	Ducks Fm.	M.	Turkeys Fm.	M.	Geese Fm	M.	Guinea fowls Fm.	M.	Chickens	Ducklings	total
Number on 1st April, 1947.	76	28	19	3	4	11	48	26	8	3	9	5	10	10	107	44	411
Number on 31st March, 1948.	32	10	12	3	12	7	22	7	7	1	9	4	11	11	34	21	203

SWINE.

The numbers of pigs are shown in Table XIII. Whereas 191 were on hand at the beginning of the year, this number was reduced to 99. The number butchered diminished greatly, as compared to the previous year, because the contract to supply 5,000 pounds of fresh pork monthly to the local military authorities, which terminated in June 1946, was not renewed. Fewer pigs were farrowed for this reason, which primarily explains the reduction in stock. Those butchered during the year under report were sold to local civilian consumers. The number of boars supplied to the United Provinces Government for distribution as stud stock increased. It is hoped the Institute may continue this contribution to the improvement of village pigs in the United Provinces. The pigs sold locally unbutchered were piglings sold to breeders at weaning time.

TABLE XIII.

Swine Statistics, 1947-48.

—	Sex	Number on 1st April, 1947	Born	Purchased	Transferred from Young Stock	Transferred to Adult Stock	Sold to U. P. Govt. (boars)	Sales local	Butchered	Died	Number on 31st March, 1948
Adult Stock	Male	12	..	..	79	..	52	..	10	5	24
	Female	42	..	..	60	..	..	..	22	24	56
Young Stock	Male	83	73	..	..	79	..	10	..	58	9
	Female	54	73	..	..	60	..	18	..	44	10
Totals		191	151	..	139	139	52	28	32	131	99
Previous year totals		189	194	22	67	67	36	..	140	38	191

BLOOD MEAL

The quantities of blood meal fed during 1947-48 are given below. The total of 8,448 lbs. is 1,780 lbs. less than a year earlier.

Poultry	1,790 lbs.
Swine	4,946 lbs.
Calves	1,712 lbs.
Total ..	8,448 lbs.
Previous year total ..	10,228 lbs.

While only 6,388 pounds were made during this year, fully a ton was carried forward from the previous year. Fewer pigs and poultry resulted in considerably smaller quantities of blood meal being used for these classes of animals.

INTERNATIONAL WOOL SECRETARIAT OPENS OFFICE IN INDIA.

A permanent office of the International Wool Secretariat has been established in New Delhi to render complete service to the Indian wool user. Function of the Indian office is to advise producers and consumers on problems of wool. Office will advise sheep breeders and wool growers on the improvement of their flocks and will put at their disposal information on the latest methods on breeding, shearing, washing, grading and marketing of wool. It will provide technical advice to increase and improve the quality and quantity of wool, by suggesting better implements and machinery, especially in grading and spinning sections and the blending of local and foreign wools. Guidance provided will specially appeal to small-scale and cottage industries that are engaged in production of goods from wool in any form. Practical proposals for simplification of machinery specially in carding and spinning sections, and improvements in warping, weaving, dyeing and finishing of wool will be put forward. It is felt that better and fuller use of wool by cottage industries will greatly improve the standard of their goods. Secretariat is carrying on research work and hopes to make concrete suggestions on the introduction of machinery that can be made by village craftsmen. Pamphlets, bulletins and brochures, written with the Indian wool user in view, will be distributed through provincial Directors of Industries, co-operative societies, schools and technical colleges. International Wool Secretariat with headquarters at London, and offices in other parts of the world is engaged in reviewing every aspect of the problem of production, treatment, manufacture, distribution and consumption of wool throughout the world. Indian office of the Secretariat is at present in the Ministry of Commerce and Industry, Government of India, New Delhi.

—*Australian Agr. Newsletter.*

REPORT OF THE BIOLOGY DEPARTMENT, 1947-48

By

W. K. Wesley.

Dr. W. K. Wesley continued as the Head of the Department. Dr. S. R. Barooah who had taken study leave resigned and Dr. E. F. Vestal left for the United States.

Mr. H. N. Mehrotra continued teaching Botany. Mr. K. B. Pisharodi who was helping in the teaching of Biology left during the year for New Delhi to conduct research work, and Mr. S. D. Mattur was appointed in his place.

Botany and Plant Pathology :—

Plant Pathology.—This year we were very fortunate not to have much damage done by Rusts on wheat crop. The rusts appeared very late nearly by the end of January and beginning of February. The leaf rust (Puccinia triticina) was difficult to find on the plants, though stripe and black rusts became in plenty by the end of February. As the disease appeared quite late in the season, the damage was very little to the ears.

The Bordeaux mixture of the strength 4 : 4 : 50 has proved very satisfactory in checking the spread of the Leaf Spot on beans. I received some specimens from Jyotipur, C. P., of this disease and I advised them to use B.M. of this strength which has checked the spread of the disease there also.

Plant Cytology.—I started doing some work on cytogenetical studies of citrus genus. So far no work has been reported in India which is on record. This year two things has been done, first the stomatal study and the second the correct size and time of the chromosomanal division.

Various species of citrus were examined and it has been noticed in certain cases like grapefruit (C. paradisi), Pummelo (C. grandis) and gulgal that the leaves, and fruits are not only bigger but the size of stomata and stoma is also double in these cases then in Kagji lime (C. aurantifolia) and mandarines.

The bud size was also determined which showed the meiotic division in anthers. There is a great variation in the size of buds. Just like in the case of Kagji lime the bud size which showed the division in the anther was between 0·2 to

0·4 c.m. while in the case of grapefruit and gulgal it is nearly from 0·5 to 1·0 c.m. In order to find out the correct time for the meiotic division the correct sized anthers were taken, fixed in acetocarmine and studied under microscope with half an hour's interval for 24 hours. The best division time in anthers was found to be between 11-15 a.m. to 12-30 noon.

Further work on these lines are being continued and will be published from time to time.

Entomology.—Mr. R. C. Sharma who had taken up a special study of the guava pests left for study abroad. *Heiroglyphus* which used to be greatly harmful to the *juar* crops in the farm ordinarily, was not seen very much due to the floods almost all over the farm this year. A study of *Nephotettix* is being carried on which is found to be very bad sometimes specially during the years of flood.

REPORT OF THE CHEMISTRY DEPARTMET, 1947-48.

by

J. C. GIDEON, M. Sc., B. T.

Staff.—During the year under report the staff remained much the same as last year. Mr. A. P. Brocks remained Head of the Department, Mr. J. C. Gideon took charge of the classes previously handled by Mr. C. O. Das, who continued his study at Ohio State University. Mr. P. Z. Abraham, B. Sc. Hons. worked until November and left to joint the M. Sc. final class at the St. Stephen's College, Delhi. Mr. N. M. Chopra, M. Sc. Hons. (Punjab) formerly of the staff of Forman Christian College, joined sometime afterwards and took charge of the work formerly handled by Mr. Abraham Dr. B. B. Malvea, Principal, Ewing Christian College, continued to deliver lectures in Agricultural Bio-chemistry to the B. Sc. (Agr.) classes.

Supplies.—The supply situation remained much the same as last year. Most common pieces of appratus and chemical were available in the market, but there were still a few we were anxious to procure and we were not able to get. In one or two instances we got small supplies direct from U.S.A. We purchased more than our average supply apparatus and chemicals due to the doubling of the II year Ag., and it meant more capital investment. Inspite of the high prices and non-availability of a few things we were faily well off as for the supply situation was concerned.

Activities.—According to the original programme of the Institute another section was admitted to the II year Agr. (Intermediate Agr.). This resulted in are distribution of work among the staff. No additional staff could be engaged as none was available to our satisfaction. This resulted in extra-load of work for all members in the Department. I take this opportunity of expressing my thanks and appreciation

to these men. Because of the extra-load of teaching duties, we could not take up any problem for research or study. It would be nice if the teaching load could be reduced a little to give more time for correction of paper, notebooks, preparation and supervision (which is our primary responsibility) and also for study of modern literature on the subject, research and writing of suitable articles for publication. A department of this sort should write art.cles suitable for publication for the lay men and the advanced students of agriculture.

Beside the usual analysis of milk samples tested for the diary and analysis of chemicals of doubtful composition, we analysed samples of Iodized Casein for the Animal Husbandry and Dairying Department for Iodine content. We also studied methods for the detection of adulteration of milk by cane-sugar—a problem referred to us by one of our former students and colleagues now working for a dairy in Calcutta.

HARDFACED PLOUGHSHARES PASS THE TEST.

Trials of hardfaced ploughshares at Hawkesbury College have confirmed the success of this process in other countries.

The shares used in the trials were hardfaced with 'Cobalide' alloy, deposited along the cutting edge and point with oxy-acetylene welding. Cost of the process is far less than half the original cost of the shares.

Land used for the trials consisted in pipe clay and ironstone gravel that had worn out untreated shares in 2½ days.

Hardfaced shares lasted 21 days, and could then be given a further lease of life by re-facing.

—*Australian Agr. Newsletter.*

REPORT OF THE EXTENSION DEPARTMENT, 1947-48.

(A. T. MOSHER, Ph.D.)

The second year in the life of the Extension Department has shown its staff at work in varied fields of rural activity, and demands for its service have been increasing from various bodies in the Dominion of India, and in one instance, from Pakistan.

Dr. A. T. Mosher's appointment as Principal of the Agricultural Institute in March, 1948, did not terminate his services as Head of the Extension Department, although his four-months visit to England and the United States invloved the temporary appointment as Acting Head of the Department of William D. Hall, who is loaned to the Institute by the India Mission Disciples of Christ, located in C. P. Mr. A. N. Singh, B.Sc. (Ag.) continues to represent the department in the field as our Extension worker with the Disciple Mission. His headquarters are Takhatpur, Bilaspur, C. P. Our other staff extension agent in the field is Mr. W. R. Chester (B. Sc. Ag.) who acts as Extension agent to the North India Synodical Board and is located at Mainpuri, U. P. Both of these men were members of the department last year. Mr. J. B. Chitambar joined the staff in July to continue the work so sadly ended by the death of Mr. S. S. N. Lal. His work will be mainly with the villages in the immediate vicinity of the Agricultural Institute and with the short courses. The Rev. C. Murray Rogers has continued as a member of the department, taking responsibility for the short courses and counselling in various parts of North India, as well as serving as chaplain for the Institute.

The work of our two agricultural advisors has developed during the year. They have been instrumental in introducing improved poultry and improved seeds, and in the U. P. extension project a number of improved implements have been sold. During January Mr. Singh conducted a three-day agricultural exhibition in the village where he lived. In this he received the co-operation of government officials, and Mr. H. S. Azariah came to represent the staff of the Institute. It is hoped that more members of the Institute Staff will be able to visit these Extension projects to counsel in their subject matter fields and to see how improvements are working out in actual practice.

Another service that the Extension Department has undertaken this year is investigation and gathering of information for various organisations. Mr. Rogers spent more than two weeks in West Pakistan in April interviewing government officials and carrying on personal investigations to see what could be done about the difficulties of displaced Christians in West Punjab. In August and September the department has gathered information about the landholdings of Christians in U. P. in preparation for a meeting called by the N. C. C. for determining the probable effects on Christian farmers of the proposed abolition of Zamindari.

There has been an increasing number of requests for members of the staff to visit different areas for counselling and conference. During this year members of the Extension Staff have visited Madras, Travancore, Bombay, East Punjab, and West Pakistan. Numerous trips have been made in U. P. and several in C. P. These personal visits of Extension personal make the services of the Institute available over a much wider area than was formerly possible. In additi on, letters requesting help or advice on rural problems are now channelled through the Extension Department so that a file of information may be built up and an information service established.

The Farmers' Fair was led again this year by the Extension Department with assistance from the entire staff and student body. An effort is being made through the Farmers' fair and the Jumna Par extension project to bring a greater influence upon the vicinity of the Agricultural Institute. Mr. Chitambar is carrying on the work started by Mr. Lal in the nearby villages.

The Extension Department has been instrumental in promoting the Christian Rural Fellowship in India both by organizing meetings and producing literature. The director of the department has also acted as Executive Secretary of the Fellowship. This year Fellowship meetings were held in three language areas and others are to be held soon. These bring together the rural leaders and enable them to share their experiences and gain help for carrying on more effective work.

It is hoped that each year this Department may bring to the Institute some prominent rural leader from abroad, not only for the training of Extension workers, but so that the entire institute may profit from lectures and discussions with him. In January Dr. W. A. Anderson of Cornell Uni-

versity visited India, making the Institute his head-quarters. He gave a series of lectures explaining the contributions sociology must make toward realising the goals of the New India. He also led a series of four seminars for extension workers. These were attended by members of the Institute Extension Staff, the staff of India Village Service, and the supervisors of the village education programme of the North India Prsbyterian Mission.

One of the most promising phases of the programme has been the Short Course for seminary students. This year it included students from Jubbulpore and Yeotmal. Each morning during the course is devoted to lectures and practical work in agriculture, with lectures being given by mombers of the Institute staff. The afternoons are spent in doing practical work and learning methods of introducing improvements into the village. In the evenings, the students are led in a series of discussions on the relevance of agricultural improvement to the spiritual life of village people. During the present year more seminaries will be represented and plans are being made to include missionaries and others. It is hoped that within a year a Hindustani short course may be introduced.

One of the services of the Extension Department is co-operation with various Christian organizations and help in the production and distribution of teaching materials. In April a meeting of a group of women working on the Christian Home movement was sponsored at the institute. As a result of this meeting the department has agreed to be responsible for the publication of a Kit of Christian Home Materials for young People, Seniors, and Juniors in Urdu, English and Hindi. These materials are now in preparation. The department has also agreed to use its field men and the centers in which they work for the introduction of such programmes and materials and to establish Circulating Librates. It is hoped that the Extension Department may in this manner serve to integrate the work of various rural groups and committee and may help in the production and distribution of literature in connection with their programmes.

(Sd.) W. D. HALL,

Acting Head of Dept.

REPORT OF THE HOME ECONOMICS DEPARTMENT, 1947-48.

(GLORY C. AZARIAH, B.Sc., HOME ECONOMICS).

The Home Economics has had some unexpected changes during the year under report. Due to the change in the system of Education we have had only a limited number of students in the first year of Home Economics. We have Indian Music as our optional subject and some students are very much interested in it.

During summer the Nestals left for U.S.A. We are so grateful to have had Mrs. Vestal in the department. Her intelligent organisation ability had been a boon to the department. Due to her great efforts we were able to secure recognition for our Intermediate in Home Economics. We do hope the Vestals will visit us again.

We had a formal opening of the Nursery School in July. Mrs. John Mathai the wife of the Finance Minister of the Central Gevernment performed the opening ceremony. Miss Evelyn Warren who is in charge of the Nursery School has had her training under Miss Sweeny. She has also spent some time at the Y. W. C. A. School of social work in Delhi. Her initiative and cheerful disposition attracts the children so much that they go to school even on vacations. We have 15 children in the Nursery School. We hope to use this Nursery School as a laboratory for the students who will be trained in Nursery School, teaching and child development.

STAFF.

Mrs. Azariah—Officiating Head of the Department and teaching Sociology, Child-care and Sewing.

Miss Argenbright—Warden of the Hostel and teaching Food Preparation, Nutrition, Textiles and Home Management.

Dr. Hayes—Teaching Hygiene and Physiology.

Miss Prasad—Teaching Music.

Miss Simeon—Teaching English and Psychology.

Mrs. Vaugh—Teaching Handicrafts.

Miss Warren—In charge of Nursery School.

Mrs. Mosher—Adviser for the Nursery School.

We are looking forward to Mrs. Koshy's return from the United States. Her training in America will be a great help in opening the third year in the department in the near future.

ANNUAL REPORT OF THE DEPARTMENT OF HORTICULTURE FOR 1947-48.

[T. Dean and M. Sharif.]

There was no change on the staff during the year except that Mr. T. Dean became the Officiating Head of the Department from 1st of December, 1947.

In general the trees did not produce very satisfactory crops due to one factor or the other with the result that the total return from the commercial side was just enough to balance the expenditure. The performance of the commercial orchards with respect to their bearing was as follows:

1. *Mango*—The mango crop on the whole produced good crop but due to strong hot winds (Loo) during summer many of the branches on which the fruits were set dried out and the fruits could not mature. One of the new varieties of mango introduced some times back known as Hathijhul produced very large sized fruits. As the tree were sold to the contractor the fruits were harvested before maturity hence nothing can be said about the quality of the fruits.

2. *Citrus*—The citrus trees especially Grapefruits, maltas, tangelo, lemons and limes produced satisfactory crop but about 50% of the crops dropped down during summer.

3. *Guava*—The guava as usual produced satisfactory crop. The red skin variety also produced quite a good fruit.

Observations on new varieties—All the new varieties introduced in the orchards in the previous years were growing well. The guava varieties, seed of which were obtained from Riverside California, gave a satisfactory performance and some of the trees were found to produce flowers.

Introduction of New Varieties.—A few new varieties were introduced in the orchards. A variety of lemon, seeds of which were obtained from Bhadri was planted in the orchard. The fruits are as big as Athani and a single fruit is found to produce 4 lbs. of marmalade. It can also be a very good fruit for sqash making. Turkey fig and largestomia thurlii obtained from the Superintendent, Government Gardens Lucknow, were also introduced in our Nursery Besides these there are many new plants in the Nursery which are kept under observation.

Research.—Due to lack of staff and fund no big research problem could be taken in hand. However minor experients were carried on during the year.

1. *Manurial trial.*—A manurial trial was started with papaya to see the effect of manures on the control of Fusaium. The general observations indicated that though the application of compost gave a better results than the fertilizers, the control against the disease on the whole was not very significant. On the other hand the application of fertilizers at the surface had the tendency of encouraging the feeding roots to develop within a few inches below the soil thus making the plant shallow rooted. Later when the fruits were set on the tree many of these shallow rooted trees fell down. The fruits on the average was somewhere between 4 lbs. to 6 lbs. (detailed report will be submitted later.)

2. After many years of papaya growing an attempt was made to select out desirable varieties in papaya. Fruits of desirable type were selected from the standing crop and the seeds were carefully collected. The trees were planted in the orchard and the fruiting will be observed this year. At the time of writing this report most of the trees were killed by flood.

3. An experiment with Nematocides for eel worm and fungus control against papaya was started by treating the trees in a randomised experiment with Iscobrome and Iscobrome D. These plants also died due to flood before any observation could be taken on them.

4. It is believed that seeds taken out from a particular portion of guava produces trees true to type. With this idea in view the seeds were collected from upper half, lower half and middle portion of different safeda guavas obtained from Bhabbakarpur. The seeds were put in the nursery. The plants are not yet quite grown up for putting in the orchards.

5. The pollination of fig was carried on and the fruit set was as usual. There were many trees, obtained from the seeds, produced by pollination in the Institute that were found to set fruits without artificial pollination. Further observation on these trees will be made carefully. If the trees will set fruits without artificial pollination, it will solve a great problem of fig growing.

6. Some breeding in citrus was tried between Pommelo and Malta. The pollination was successful and fruit were set. Before the fruits could mature they dropped down due to hot summer winds.

Insects and Diseases.—The insects as usual were present in the orchards. Most common were :—(1) fruit moth, (2) mealy bugs, (3) catterpillars of lemon butterfly, (4) citrus leaf minor, (5) stem borer of guava. Control in most of these cases was done by mechanical means except for the stem borer of guava in which case the use of petrol was made.

Diseases continued to be serious. The following were most common :

1. *Cephalospora disease of guava.*—It was not so serious as last year.

2. *Fusarium in papaya.*—It was rather serious. The loss due to this disease was about 50%. Manurial trial was made for its control.

3. *Gummosis.*—Few of the trees were affected by this disease but was controlled by Bordeaux paste.

4. *Wither tip.*—This was not noticed in many of those trees that are susceptible to the disease as they were sprayed with Bordeaux mixture in the month of February.

5. Die back was noticed in some of the Orange trees.

Fruits products like jelly, jams, chutneys, candied fruits and vegetable, guava cheese, fruit juices were manufactured under the Fruit Products Control Order of the Government of India and were quite popular during the year.

ZEBU CATTLE CROSS SUITS SMALL HOLDINGS.

During the last seven years considerable progress has been made in Queensland with experimental crossing of Zebu with other cattle. An investigation, after six years since the previous check, showed that cross-breeding with Zebu strains had been extended from 5 to 59 centres, and the original 19 Zebu cattle imported had produced crossbred progeny now estimated to exceed 15,000. It was found that these crossbreds had made most progress in areas where holdings are relatively small. On the larger holdings, the wildness of the crossbreds restricts their usefulness.

—*Australian Agr. Newsletter.*

Published by :—The Allahabad Agricultural Institute, Allahabad, U.P. (India.)

THE

ALLAHABAD FARMER

A BI-MONTHLY JOURNAL

OF

AGRICULTURE AND RURAL LIFE

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BI-MONTHLY JOURNAL OF AGRICULTURE AND RURAL LIFE

The Allahabad Farmer is now approved by the Directors of Public Instruction in the United Provinces, Bengal, Central Provinces, Sind, Assam, Bihar and Orissa, the Rural Reconstruction Commissioner, Punjab, and by the Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to Rajputana and Central India States, for use in all schools under their jurisdiction.

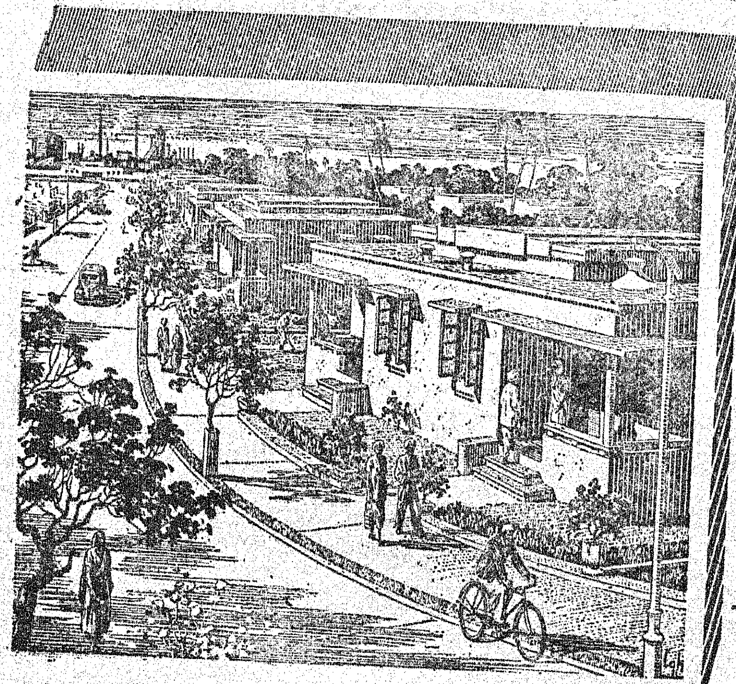
Subscription Rates

Annual subscription: India, Rs. 3; England, 4 shillings; U. S. A., 1 dollar. Single copies 10 annas; over five years old, 12 annas. Copies which are not received by subscribers will be supplied free of cost within six months of the month of issue. Thereafter single copy price will be charged.

Unused portions of subscriptions cannot be refunded.

Publisher—The Allahabad Agricultural Institute, Allahabad, U.P., (American Presbyterian Mission).

Printer—The Mission Press, Allahabad, U. P.



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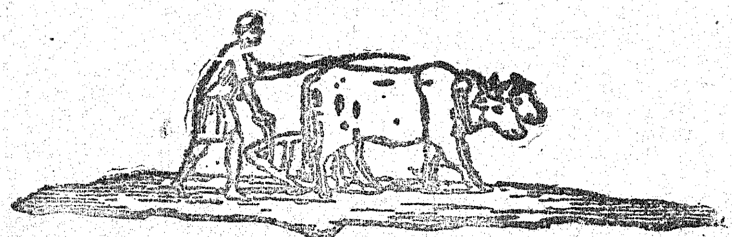

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EDITORIAL

THE NEED FOR A FLOOD FORECASTING SERVICE

The U. P. and Behar have again been visited by a disastrous flood, the highest since 1875, and villagers report that in spite of the official river level being slightly lower than in 1875, the water at places reached levels not reached them. Thousands of families have had to vacate their homes, in some cases with barely time to save their belongings, thousands of houses have fallen down, crops have been destroyed, stores of food grains have had to be removed and in some cases it was not possible to remove them after it became known that the flood would reach dangerous levels.

The Agricultural Institute, home of the Allahabad Farmer, also suffered in the flood. The Farmer Office was flooded, files of back numbers and other papers were removed to higher levels which were also flooded and as a result much of the records of the Farmer and most of the stock of back numbers has been spoiled by water. An attempt was made to restrain the flood by an embankment or levee which had been successful in previous years but the embankment was overtopped and broke. Later it was evident that even if the embankment had kept the water out from one side, it would have done no good as it came in from behind from other directions. Had the height of the flood been properly predicted in advance, considerable expense in making the embankment could have been saved.

After the flood was over, information was given in the papers as to the cause. There were rainstorms giving a total of some 10″ to 12″ of water in a short period of one or two

days in each of the three water sheds, that of the Ganges, the Jamuna and the Chambal, at such a time that the resulting flood runoff all arrived at Allahabad at the same time. These rains occurred some two weeks before the floods reached Allahabad and were duly recorded by the meterological stations concerned. Little or no information about them appeared in the papers in the plains.

During the whole of the period of about three weeks during which the flood was rising and at its height, little or no information could be had as to the probable future course of events. Daily the news papers recorded the height of the river at various points on the day before. Little or no information was available as to the probable future course of events. Apparently some information was available to district authorities and the Police but it was not made public generally so that private citizens could make intelligent plans. The attitude of the press as reflected in the news stories seemed like that of the mythological "Woofus Bird." It is said to have been entirely normal in all respects except that it insisted on flying backwards. It was not much concerned with where it went as long as it could see where it had been. We had columns of reports about what had happened yesterday but no news of what might happen today or tomorrow or a week hence.

While it is true that much of the damage could not have been prevented in any way whatever, it is also true that advance information of the height, time of arrival and duration of the flood would have made possible planning and action by individuals and authorities which would have made unnecessary some useless expenditure and which would also have made possible actions which would have greatly minimised the damage and suffering which resulted from the flood.

It seems clear that prediction of the flood could have been easily possible, had there been someone whose duty it was to do so. Meterological data is available for 75 to 100 years back and in some cases for longer periods which records the precipitation in the various water sheds. For a similar period, the Public Works Department and the railways have noted height of the river stage at various points. A study of these records should show the time taken for a rain of a given intensity over a given area to provide enough water to materially affect the river level at a given point. From these records it should be possible to predict the time taken for the

crest to travel from one point to another, from Karpur to Allahabad for instance.

It should not be difficult to correlate the data for individual watersheds to provide a prediction of the combined effect of floods in two or more watersheds. Predictions are now made of the probable local weather for periods of one or two days in advance. It seems that it would be easier to predict the progress and height of a flood than to predict a rainstorm. Surely water moving in a river channel moves more reliably and predictably than does an atmospheric depression. With the data now recorded by various agencies, it should be possible to prepare tables of graphs showing the correlation between precipitation and flood level. With these tables or graphs, it should be possible to predict days or weeks in advance the exact stage of the river day by day and hour by hour. Perhaps if there is a public demand for such a prediction service, it will be provided.

It is not enough that it predict the stage one or two days in advance. The prediction should include the rate at which the river may be expected to rise and as early as possible the maximum height to which it is likely to rise and the probable date. It is certain that such prediction, once the public acquires confidence in it, will result in material saving of property, food and shelter and in many cases the saving of life of men and animals. It is not possible to avoid all the damage resulting from floods; let us avoid as much of the damage and suffering as possible.

BACTERIAL INOCULANTS ARE IN DEMAND

Use of bacterial inoculants for treating seed has given such good results in Australia that the demand for this material has been rapidly increasing. The Waite Agricultural Research Institute, of Adelaide, which prepared the inoculants for farmers in South Australia, had to develop improved methods of preparation to increase the supply. In the year up to last June, the Institute sent out 1,700 prepared cultures, mainly to farmers in the newly developed pasture areas of the south-east and on Kangaroo Island. Most of the inoculants were used for treating the seed of lucerne and subterranean clover.

Fifteen different strains of inoculant are prepared at the Institute for commercial distribution. It is supplied in standard units sufficient for treating 50 lbs. of small legume seed, or three bushels of larger seed such as peas.

DRY WEATHER PLOWING EQUIPMENT

By

Mason Vaugh

When I first came to India and the Agricultural Institute, in the early 1920's, dry weather plowing for the following monsoon and ensuing crops had been recognised by many as a useful way of smoothing out the very high peak of work in the early days of the monsoon and some had recognised that it was good soils practice as well. For a long time, in certain parts of Central India and the Central Provinces, it had been the practice to use a very heavy and strong wooden plow with several-some times as many as 5-pairs of bullocks on one plow for occasional deep dry weather plowing of certain types of soils.

It had already been recognised that the comparatively light plows from western countries, particularly the ones made of cast iron, would not stand up to the job. The cast iron plows broke. The lighter steel plows either wore excessively or bent and twisted or both. Plows with large mold boards designed to pulverise the soil were man and bullock killers. It was impossible to pulverise the hard dry soil in April, May or June and often as early as March the soil was too hard to pulverise. It took a wrestler to keep such a plow even approximately to its works.

The bar point had been devised as a mean of counteracting the heavy wear on especially the points of shares and to reduce the necessity of frequent taking to the smith for sharpening. Ransomes, Simms and Jeffries had brought out two versions of the barpoint, especially with hard ground plowing in view. The "Sabul" was a more or less conventional mould board plow with a steel beam, cast frog, bar point and steel mould board and share blade. It was ruggedly built and strong enough to stand up to heavy work. It would do a fair job of soil inversion when the soil was reasonably moist and could be kept in the ground and made to break it up even when the soil was quite dry and hard. The name "Sabul" was apparently taken from the Hindustani word meaning iron bar.

The other bar point brought out by Ransomes about the same time was very similar in general construction except that it had very small, almost rudimentary mould board and share blade. It was called the "Pathator" or "stone breaker". It was fairly successful as a hard ground plow

but was practically useless for anything else. The cost was so high as to make it unattractive as a single purpose tool. It never acquired any wide popularity and one is now rarely found even in old collections of implements. The Sabul was widely sold to Government farms and large land holders and one is occasionally found in use.

The Agricultural Institute early accepted dry weather—not necessarily " hot weather "—plowing as standard practice. From the very early days of the Institute we have tried to plow up all fields sometime during the period between the beginning of December and the middle of June. Even where arhar was mixed with a kharif crops, it was often sown in fairly widely spaced lines so that dry weather plowing between the lines could be done before the arhar was harvested. As fast as fields were harvested after around December first when the Rabi sowing could be expected to be entirely finished, the fields were plowed.

From this early experience, several basic ideas were formulated. First we recognised the practical impossibility of soil pulverisation at this season and became convinced that it was probably both unnecessary and undesirable as soil handling practice. All that was necessary or desirable was to loosen and roughen the surface so that drifting organic matter would be held between the clods and so that the first rainfall of the monsoon would be caught and absorbed. Secondly we became convinced that soil inversion at this season was both impracticable and unnecessary. In breaking the soil up into clods some of them are more or less rolled over which does no harm. These two conclusions added up to the point that a dry weather plow did not need a mould board at all. Thirdly, we became convinced that it was impracticable to keep a wide share sufficiently sharp to secure penetration. Excessive weight did not greatly help in getting penetration. We came to believe that the point must be of steel, easily removed for sharpening and not requiring any great skill for sharpening. It must be wide enough to given " burden " enough to keep it from tearing out through the soil, narrow enough so that excessive force would not be required to force it into the soil. Fourthly, we felt it necessary to get a plow which could be held to its work with a moderate amount of effort by the operator and of course which did not require excessive power from the bullock. Fifthly, we were convinced that a plow to be used only for dry weather plowing and laid aside at all other seasons would be too costly to become popular.

From an attempt to combine something which would meet all the above conditions, we arrived at the U. P. plow. We decided that a heavy plow should have a steel beam of the general type found on medium and large size American plows. We decided that it should have a conventional general purpose steel mould board or soil inverting bottom for use in seasons when soil moisture was sufficient and particularly for turning under green manuring crops. We decided that the simplest way of adapting it to dry weather conditions was to develop a complete different bottom. From this decision, the U. P. Plow with interchangeable rooter, mould board aud furrow maker bottoms was developed. Only the idea of interchangeability and the rooter bottom were new ; the mould board aud furrowers were conventional.

In developing the rooter bottom, we first tried the bar point idea with its obvious advantages. A similar idea had been used successfully to break up old macadam roads. However, we found the bar point too narrow to carry enough "burden" to keep it in the soil. None of the variations we tried would do more than scratch a narrow mark. We knew of Howard's "Kans plow", which was simply a double mould board or middle breaker plow with the mould boards taken off, so we tried that. It was possible to work it early in the season when the crust of really hard soil was shallow and it was possible to keep the share in soft soil below. When the soil became really hard down to plowing depth, it just did not function.

However, from it we developed a really satisfactory rooter share which was essentially the same shape as the central part of the middle breaker share or "kans plow" share. It had the same shape but was only about 6" wide, at the widest part over the frog. The whole bottom consisted of the frog and the share. The frog was simply a bar fastened to the beam and a flat piece welded to it carrying the share at the lower and extending up the beam to protect it from wear.

The size and shape of the share allowed it to penetrate readily, even when the soil was quite hard, it had enough "burden" to stay in the soil and run steadily, and enough wedge action to cause the soil to the break away into clods readily. The bottom was symmetrical so there was no tendency to force the soil to one side or the other but only to raise and shatter it into lumps. Of course, after the first round, the fact that the soil was broken up on one side and solid on the other led to most clods breaking away from the

unploughed land toward the plowed part but the plow was not thrown round when large lumps broke away. Since the lumps broken out were not uniform in size, the plow does not run with the steadiness of a wide mould board bottom in clean soil. It was found easier to control if the hitch were set a bit too deep so that the plowmen could "ride" the handles a bit. In abrasive soils which were hard and dry, it was desirable to sharpen the shares daily but this was a comparatively simple operation. When the point of the share wore away to the extent that it was no longer serviceable, we found it easy to make a new point only to be rivetted on with three rivets. This patch point could be replaced two or three times before the original share was worn at the back part to the point where it was no longer serviceable. This meant that the cost of shares was not excessive.

Standard practice from the early days was to use the ordinary mould board or soil inverting bottoms as long as one pair could pull them. From the beginning the rooter bottom was considered suitable only for use with two pairs of oxen and at the end of the season, when conditions became the worst, we often used three pairs on one plow. It was accepted without question that dry weather plowing. particularly toward the latter part of the season, was only possible with large oxen and heavy plows. It was assumed without question that the small farmer with only small oxen and small plows suited to them could not utilise dry weather plowing.

Later, when the "rainfed" experimental farm at the Agricultural Institute was started, particularly to explore the problems of the small farmer, having only a small area which would in turn justify only a pair of small oxen and small implements and having little or no irrigation, we began to try to find ways of bringing the advantages of dry weather plowing to such farmers. Land in Kharif crops harvested by December, usually retained enough moisture to make plowing possible without too much difficulty. If arhar was planted in rows in such crops, it was possible to plow between the arhar with little or no damage to it. The Rabi crops harvested in March presented another problem.

It was noticed that just at the time of harvest, the soil of fields growing wheat, barley and even chana was still workable when the crop was harvested but that its condition changed rapidly in the first few days after the harvest. It

was assumed that the farmer having only 2 or 3 acres of wheat could arrange to plow them more or less as they were harvested, in the period while the crop was still too damp and green to actually start threshing. This was recommended and is still considered good practice for such conditions. It was found that the small 6″ steel plows would work under these conditions fairly satisfactorily for a week or so after the harvest.

The rainfed farm however was 40 acres and several years weather conditions resulted in having more than half of it in Rabi crops. Most of the time only two pairs of small animals were available for the plowing. Obviously the area could not be covered in the time available. Work was started as soon after harvest as possible and use was made of several different small steel plows. The Wah Wah, the Shabash fitted with both long beam of the "deshi plow" type and a short wooden beam for use with a chain and the U. P. No. 1, a smaller version of the original U. P., using the same basic bottom as the Wah Wah and Shabash were all tried. The rigid beam type plows did not work well for dry weather plowing after the soil got really hard. The short wooden beam Shabash worked fairly satisfactorily, though some difficulty was experienced getting the beam strong enough to avoid breakage. The men showed a fairly strong preference for two handles for dry weather plowing. To our surprise, the U. P. No. 1 even with small animals weighing only about 750 to 800 lbs. each was quite successful. The cut of the share is some 6″ but the width of the mould board just above the share is little more than 4″. In most soils tried, the clods are usually of a size that can be easily pushed aside and the small plow works more like a rooter than like a soils inverting plow in dry hard soil. We expected the animals to show strain and the men were instructed to use two pairs if they began to lose condition. However, we found that when the going was particularly hard, they reduced their rate of travel and consequently the area covered in a day but were able to keep right on until the end of the season. The quality of work was quite satisfactory, not inferior to that done with the rooter. The larger animals with the larger plow are able to do more work, to cover more ground in a given time, than the small out fit. The quality of work when carefully operated that is turned out by the small outfit is not inferior to that of the larger outfit. We were also surprised to find that the strength of the U. P. No. 1 was sufficient for this type of work. It was originally designed only for the

lighter work of other seasons but proved to be able to take the strain without difficuly. Only one or two lighter than standard beams gave some trouble when the plow became stuck under an unsually hard clod and the animals swung to break it out. None gave trouble on reasonably straight pulls.

This experience, checked for some five years, would seem to show that dry weather plowing is entirely practicable for the small farmer having small animals and with implements that are not excessively costly. While not as stisfactory for turning under green manuring crops as a larger plow, the U. P. No. 1 with a 6″ bottom is adequate for other work on a small farm and can be used for green manuring.

The animals used in this work are not better than those found in many villages. They weighed about 750 to 800 lbs., about 10 mds. Probably half the bullocks used around Allahabad on farms would be about this size or larger.

While the price of the plow is higher than the generally accepted maximum price which farmers will or should be asked to pay for a plow, I belive that it is not above what many small farmers can afford. Even at present inflated prices, it can be sold retail for Rs. 45-0-0. Being usable all year round, many farmers will be prepared to pay this much.

Mr. C. Maya Das, the recently retired Director of Agriculture, in an article in the spring of 1947, pointed out that the general introduction of two practices, dry weather plowing and green manuring with the other changes they would make possible in the Agriculture of the U. P, could increase the yield of food grains in the U. P alone by a figure approximately that of the all India food grain annual deficit. It would seem to be worth while to make an effort to introduce these practices.

I SHALL TRY TO CORRECT ERRORS WHERE SHOWN TO BE ERRORS; AND I SHALL ADOPT NEW VIEWS AS FAST AS THEY SHALL APPEAR TO BE TRUE VIEWS.

—Abraham Lincoln
(On his Statue at Washington)

PAPAYA AND ITS PROPAGATION

By

T. Dean, B.Sc. Ag.

The papaya (carica papaya) is a native of tropical America. Its introduction into India dates back 300 years, and most probably it was done by the Portuguese. Its cultivation has spread throughout the world and is an important fruit crop of Hawaii. Its introduction in U. P. is rather recent.

Since 1933 the Agricultural Institute has started the Papaya plantation and have never experienced the least difficulty in selling the entire crop. During the last two years people seemed to have realized the importance of its cultivation and new orchards have sprung up in the area around the Institute. In order to help those who are interested in the crop, the article is written to give some idea about the methods of propagation.

Botanical Description.—Papaya belongs to the (family) genus Carica which was originally classed under Passifloreae and sometimes under Cucurbitaceae. According to the recent classification, papaya is included in a small family Caricaceae. This includes about 25 species but only two are of horticultural importance.

Plant.—Papaya which is botanically called Carica papaya is a very interesting plant both from the botanical and the horticultural point of view. The papaya is a large herbaceous plant which grows to the height of 25 to 35 feet. It is dicotyledonous. The trunk is usually unbranched for a year but has a tendency to branch out after the first year. The stem is fleshy and hollow. The plant is short lived and can be grown economically for 3 years only, after which the growth slows down and yield is greatly reduced.

The leaves are palmately lobed and each lobe is pinnatified. A full grown leaf is 2-3½ ft. long and about 2 ft. across with a hollow petiole and swollen base.

The flowers—Papaya is diœcious, monoecious or polygamous according to the sex forms appearing on the plant. These sexes may be recognised by the flowers.

The primary types of flowers commonly recognised are pistillate or purely female flowers, staminate or purely male flowers and hermaphrodite or perfect flowers. By close observation several combination of these flowers are met with.

It has also been noticed that in the same orchards the same plants vary in sex combinations in its course of life. It is due to these in sex combination and cross pollination that makes it very difficult to keep a pure strain unless artificial methods of pollination are adopted.

Before going into actual methods of propagation, it will be better to have the knowledge of different types of flowers.

1. *Staminate flowers*—Staminate flowers are sessile, born in cluster, on long racemes $2\frac{1}{2}$ to $3\frac{1}{2}$ ft. long, hanging around the bare stem in a most picturesque manner. The flower is an inch and a quarter long having narrow slender base and a carolla tubular or funnel shaped, five slightly twisted petals, poly petalous united into a tube towards the base yellow or whitish in colour. The stamens are joined at the throat, filaments hairy, anthers oblong bilobed and pollen grains oval.

2. *Pistillate flowers*—These are $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long, yellow, heavy, borne on stalk along the trunk in the axils of the leaves and are usually solitary or in three or more flowered corymbs. The flowers have five green rudimantery sepals and five whitish ,yellow petals opposite to the sepals. The ovary is globose, smooth or fine lobed, made of five carpels. The pistil terminates in fan shaped fine sessile stigma, each stigma dividing into 6 to 10 small teeth.

3. *Hermaphrodite flowers*—There are three distinct types of hermaphrodite flowers. They are :

(*a*) *Elongate*—Those flowers are $1\frac{1}{2}$ to 2 inches long, five sepals alternate to petals, 5 yellow petals, gamopetalous for about two-third from below, the upper one third free. Ten anthers, some times more arranged into two series, five, subsessile and opposite to the petals and five alternate to the petals. Due to the second thickening at the joint, the corolla has a cylindrical shape. The ovary is cylindrical, longer than pure female, 5 to 10 carpels, being more common.

The fruit is usually long, cylindrical, bottle necked.

(*b*) *Pentendrica*—These flowers are $1\frac{1}{2}$ to 2 inches long. Smaller than female and elongata, 5 petals, polypetalous, joined at the base, stamens five, filamentous, alternate with the petals. The pistil is globose, five carpels deeply grooved, the stamens lie in the grooves.

The fruit is oval deeply grooved, there is prominent disk at the stem end which is formed by the scars of the fallen carrolla.

Existing and desirable consumption (prewar.)

Ounces per day per adult (or Consumption unit)			Total quantities in million tons	
—	Required for a balance diet	Available	Required	Available
Cereals ..	16	18·5	48·0	55·5
Pulses	3	2·5	9·0	7·5
Sugar	2	1·8	6·0	5·3
Vegetables	6	3·0	18·0	9·0
Fruits	2	2·0	6·0	6·0
Fats and oils	1·5	0·6	4·5	1·9
Whole milk ..	8 per capita	1·5	32·0	6·3
Butter Milk	..	3·0	..	12·5
Meat, fish and Eggs ..	2·3	0·5	6·0 to 9·0	1·5

This is in the normal time. But as the production of cereals in present years are going down it is still worse. At the cost of our national prestige we are every year getting imports of food. Our government is every year going with a beggar's bowel to the foreign countries. It is clear from Dr. Rajendra Prasad, the ex-food minister's statement in the Constituent Assembly (Legislative) on December 10, 1947 in connection with the Government of India's revised food policy that the food which we are getting from the foreign countries is at a very high price. He said that the Turkish wheat cost about Rs. 30 per maund, Argentine maize had risen from Rs. 10 per maund last year to Rs. 13 per maund this year. He also revealed the fact that in order to meet the difference between the internally prevalent prices and the prices of imported grains, the Government of India had had to pay subsidy. The subsidy from April 1946 to March 1947 amounted to Rs. 20·59 crores. From April 1947 to December 1947 it was estimated to be something like Rs. 17-35 crores. The Government is spending Rs. 100 crores a year to purchase food grains outside. We can very easily produce our own food and save this huge amount in our national planning. By taking help of the following methods we can increase our food production.

1. *By bringing more land under cultivation*—If we can bring more land under cultivation we can increase the food

production. The following table will indicate the position and comparative changes in the land resources of British India over the last 40 years upto 1940-41 :

(*In Millions of acres*)

Classification land	Years						Percentage far
	1900-01	1910-11	1920-21	1930-31	1935-36	1940-41	1940-41
Forests ..	55	62	66	67	67	68	13·3
Not available for cultivation.	82	101	98	94	93	87	16 9
Cultivable Waste	81	89	90	94	94	98	19·1
Current fallows ..	40	42	56	46	47	45	8·9
Net area sown .	186	210	197	211	210	214	41·8

So 98 million acres of land we are leaving as cultivable waste. Again 87 million acres of land are not available for cultivation such as marshy places and swamps. In a Country where millions of people are always starving and where the average holding of cultivated area is not even 5 acres, it is in some provinces like Assam only 3 acres according to the Census report of 1921 and in the United Provinces it is 2·5 acres, it seems rediculous to see that nearly 20 per cent. of our land we are keeping as cultivable waste. Our cultivators are not going to these places because these are unhealthy and not economic. So the government should make these places economic to cultivation and also healthy. Such a drive has recently been launched by the U. P. Government in the Ganga-Khadar terai region. With the aid from the Government of India, U.P. Government is doing reclamation work in that part. It is estimated that within the next five years it will bring under plough 100,000 acres of waste land. This work has been undertaken by the C. P. Government also. Such a move should be followed by all the provincial governments. These reclaimed acres have got a bright future. We can start co-operative farming in these areas and so the general income from it will always be more.

2. *By introducing better crop-varieties*—It has been estimated that an increase of 10-15 per cent. of yield can be produced by the introduction of better crop varieties. In some cases it goes much higher than this. Besides yield the

quality is also improved and so the cultivators get good price. Again there are some improved varieties which can resist diseases and pests. That the yield can be increased by the introduction of improved varieties can best be realised by the sugarcane industry. Before the introduction of sugarcane breeding in the country the yield of canes was as low as 10 tons per acres. But after the establishment of the breeding station at Coimbatore and after releasing improved varieties all over India the yield of Canes has gone as high as 15 tons per acre. In some cases it has gone upto 30 tons per acre. As regards the quality, our Indian wheats were all soft and very inferior to the American wheats. But now our Indian wheat pusa 52 and 94 are in quality no less than the best Manitoba wheat of America. Our cultivators are always anxious to grow better varieties. It has been seen in the case of sugarcane. In 1928-29 the Coimbatore Canes were grown only in (11·6) per cent. of the total area in India. But in 1935 it was 76 per cent and now in some places, as for example, in U. P. and Bihar it is upto 90 per cent.

3. *By the use of fertilizers and manures.*—The fertilizers and manures contain the most essential plant foods—nitrogen, phosphorous and potash. The crop producing capacity of the soil can be increased by the use of two kinds of fertilizers :—

(a) *Chemical fertilizer* :—The use of Chemical Fertilizers such as ammonium sulfate, superphosphate, pottasium nitrate will give a direct increase in yield. But the difficulty with these fertilizers is their availability. These are costly to the cultivators. These are mostly imported from foreign countries. Recently a chemical fertilizer factory has been established at Sindri in Bihar which has been claimed as the biggest in Asia. Let us hope that in due time we shall get cur regular supply of chemical fertilizer. Even then we cannot hope to get our regular supply before 1952 or 1954. Should we wait till then or take some other means?

(b) *Organic manures*—Organic manures are not produced synthetically. These are produced in the nature itself by the process of decomposition of plant and animal remains and refuse. The compost manure and the farm-yard manure are the best organic manure available easilly to us. The preparation of these two manures are very easy and we do not require any costly machinary for it. It has been proved by several scientists that organic manure is better than the chemical fertilizers. It provides the plant food all in one

combination and, what is mostly needed it provides organic matter to the soil to improve the structure and texture of the soil. Prof. Dhar of Allahabad University definitely proved that the organic manure is much better than artificial fertilizer. He said in a course of lecture in the Indian Agronomical Society, Allahabad Branch, that the nitrogen from the artificial fertilizer is lost in the form of ammonia gas and does deteriorate the soil after some years of their application. On the other hand the organic manures like compost and F.Y.M., not only add nitrogen to the soil but also helps in the fixation of atmospheric nitrogen. He conducted experiments near Allahabad and proved that organic manures helps in the fixation of atmospheric nitrogen. U. P. Government has recently taken a drive for compost making. This drive was taken for three weeks in the whole Province from October 2, 1947, the birthday of Mahatma Gandhi and it has yielded about 98,000 compost pits and about two lakh tons of organic manures were thus prepared out of it which would increase the yield of wheat by two and half lakh maunds. Mr. C. N. Acharya in his 'Utilization of Village Waste' in the "Developing Village India' says that about 500 million tons of compost can be prepared every year from the refuse of the six and a half lakhs of villages in India and it would produce the food level of our Country by a hundred million tons per year—enough to feed comfortably a population of 500 to 600 millions.

4. *By using labour-saving devices*—The use of machinary in agriculture will definitely increase the production of our land. Smallness of our holdings is a hindrance in this direction. But we can start these machinaries on co-operative basis. Consolidation of holding is the crying need at present. Cost of production of our crops increases with the smallness of the holdings. B. P. Jain says, 'it is calculated that expenditure f[illegible] cultivation of land increases by 5·3 per cent. for every 500 [illegible]rs of distance for manual labour and ploughing and 20-3[illegible] per cent. for transport of manure and and 15-22 per cent for transport of crops. It has further been observed that on compact holdings the income from farming would increase by at least 20 per cent. without any modification in the method of cultivation'. Therefore it is clear from the above statement that consolidation of holding and use of machinaries is very essential in agriculture.

5. *By controlling plant diseases and pests*—Diseases and pests take away a great portion of our agricultural produce. For the last few years wheat rust epidemic has caused a great damage to the wheat crop of the Northern India.

Government of India has already started investigation in this direction. Dr. B. P. Pal in collaboration with Dr. K. C. Mehta is undertaking the task of evolving rust resistant varieties of wheat to be sown in the hills from which it is supposed that the infection comes to the Northern India. In other crops also resistant varieties have been evolved. We should be confined not only to the diseases and pests in the field, but we should control the pests of stored products also which causes a great loss.

6. *Control of soil erosion*—Soil erosion is the process of taking away the fertility of the soil by the rain water. This is at present a menace to India. Soil erosion is caused by faulty method of cultivation, deforestation and grazing of the bare lands. Therefore soil erosion can be easily controlled by scientific method of cultivation, aforestation and control grazing. This rape of the earth should be checked immediately.

Thus we have seen that in the production of more food we need co-operation of engineers, agronomists, chemists, plant pathologists, entomoligists and plant breeders, all with their knowledge in their respective fields.

"WEED POPULATION OF MANURIAL AND NON-MANURIAL WHEAT FIELDS."

By B. S. Fozdar and S. N. Singh

Introduction—A comparative study of the weed population of two wheat fields with different and well marked rotations was made with a view to study some aspects of the growth of weeds. The selected fields are situated on the Students Farm, Government Agricultural College, Kanpur. The non-manurial wheat field is a permanent wheat field in which manure has not been applied since 1913, and the rotation followed year after year is fallow—wheat. The manurial field for the 3 years preceding the observations, had the rotation green manure—wheat.

The dominent species of weeds the periodicity of germination of seeds and the frequency of their appearance were determined and a comparison of the weed population of the two fields was made.

Method.—Five quadrats, each 3′×3′ were laid out at random in the selected fields. Each quadrat was divided into 6 strips for convenience of counting. The species of weeds were counted and listed. Observations on germination of weed seeds were made weekly and after every count the seedlings were uprooted.

Observations—The initial count was made on 20th January, 1946 when the crop had sufficiently grown and the weed population was thick and the number of seedlings of each weed was comparatively more than in the successive observations. The detailed observations on the frequency and successive appearance of Seedlings have been summarised in Tables Nos. 1 and 2.

Conclusions:—(*i*) *Dominent species*:—On analysing the data in Tables Nos. 1 and 2, the following species have been found to occur in order of dominance over the whole period.

Manurial			Non-manurial		
Sl. No.	Species	Ratio of frequency	Sl. No.	Species	Ratio of frequency
1	Spergula arvensis ..	42·9	1	Malilotus sp. ..	11·7
2	Asphodelus tenuifolious	27·4	2	Lathyrus aphaca ..	11·1
3	Chenopodium album ..	23·9	3	Medicago denticulata..	9·8
4	Medicago denticulata ..	5·5	4	Chenopodium album ..	7·5
5	Vicia sp.	4·0	5	Convolvulus arvensis..	5·4
6	Anagellis arvensis ..	2·8	6	Asphodelus tenuifolius	5·3
7	Convolvulus arvensis ..	1·0	7	Vicia hirsuta ..	1·7
			8	Anagalis arvensis ..	1·2
			9	Vicia Sativa ..	1·0

TABLE NO. 1.

Manurial Plot.

Weekly counts of weed population of all the five quadrats.

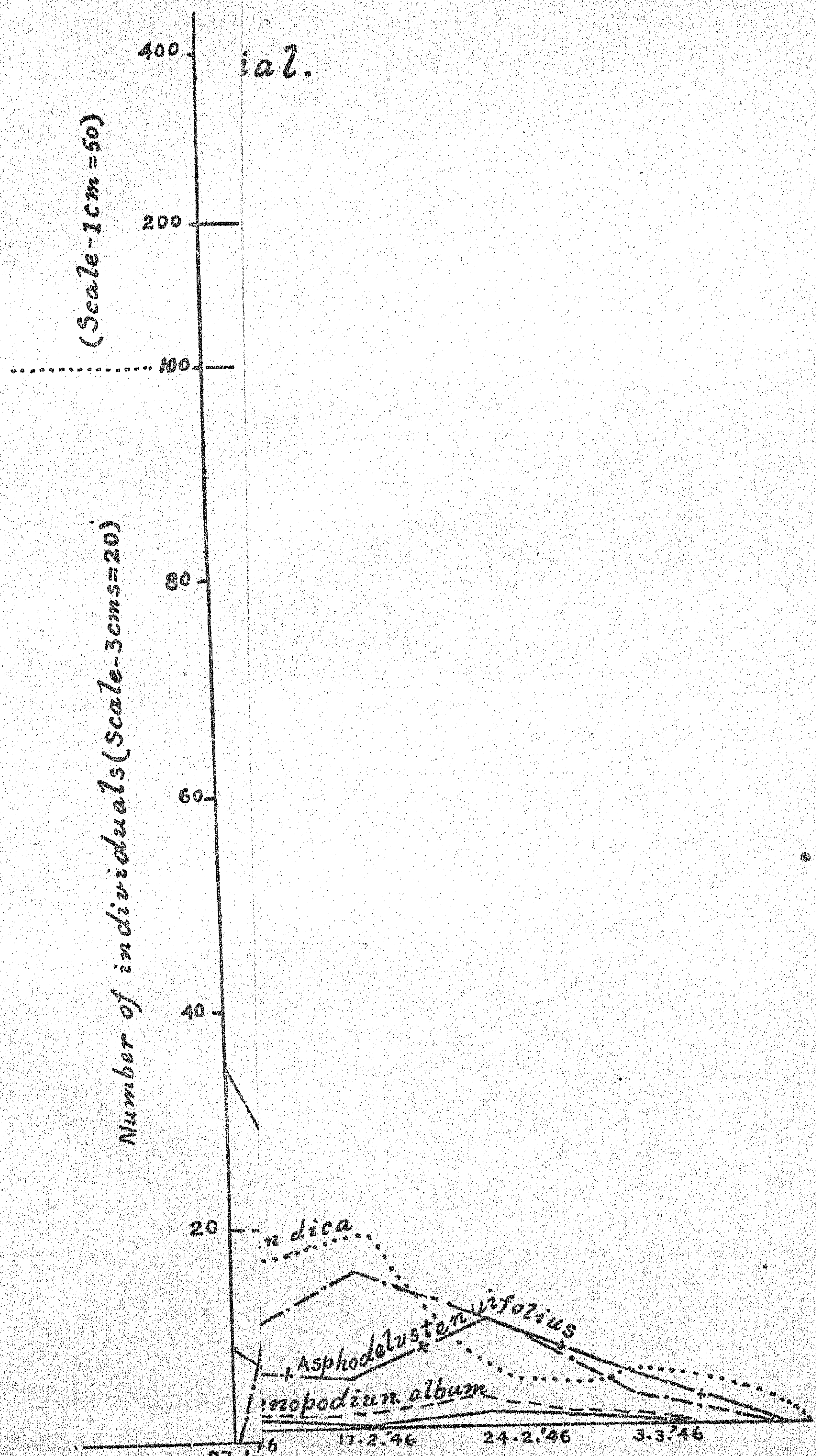
Order of dominance	Name of the weed	Dates of observation 1946								Total No. of plants	Ratio of freque cy
		20·1	27·1	3·2	11·2	26·2	9·3	18·3	25·3		
1	Spergula arvensis ..	..	..	8	223	377	162	3	..	773	42·9
2	Asphodelus tenuifolius	414	35	12	15	16	2	..	..	494	27·4
3	Chenopodium album ..	218	20	20	61	96	15	..	..	430	23·9
4	Medicago denticulata	..	..	56	15	28	1	..	..	100	5·5
5	Vicia species ..	62	7	..	..	3	..	..	..	72	4·0
6	Anagellis arvensis ..	..	..	..	..	40	10	..	..	50	2·8
7	Convolvulus arvensis	2	2	2	3	1	4	2	2	18	1·0
					Total				..	1937	
					per sq. yd.				..	387	

TABLE NO. 2.

Non-manurial Plot.

Weekly counts of weed population of all the five quadrats.

Order of dominance	Name of the weed	Frequency of weeds on different dates 1946									Total No. of plants	Ratio of frequency
		20·1	27·1	2·2	10·2	17·2	.	3·3	10·3	17·3		
1	Melilotus Spp. ..	93	5	6	15	19	6	3	5	..	152	11·7
2	Lathyrus aphaca ..	81	10	2	30	12	3	2	..	..	144	11·1
3	Medicago denticulata.	66	6	11	9	5	15	10	1	1	128	9·8
4	Chenopodium album	87	1	0	3	2	3	0	1	..	97	7·5
5	Canvolvulus arvensis.	14	2	8	11	15	9	4	3	3	70	5·
6	Asphodelus tenuifolius.	37	4		6	5	10	3	..	..	69	5·3
7	Vicia hirsuta ..	14	..	4	2	..	2	..	..	..	22	1·7
8	Anagallis arvensis..	6	1	1	..	2	3	2			15	[illegible]
9	Vicia sativa ..	12	..	..	1	.	..	..	..	..	13	1·0
						Total				..	708	
						per sq. yd.				..	142	


ial.
400
200
100
80
60
40
20
(Scale-1cm=50)
Number of individuals(Scale-3cms=20)
n dica
Asphodelus tenuifolius
enopodiun album
27.1.46
17.2.46
24.2.46
3.3.46

gure-1

Non-manurial.

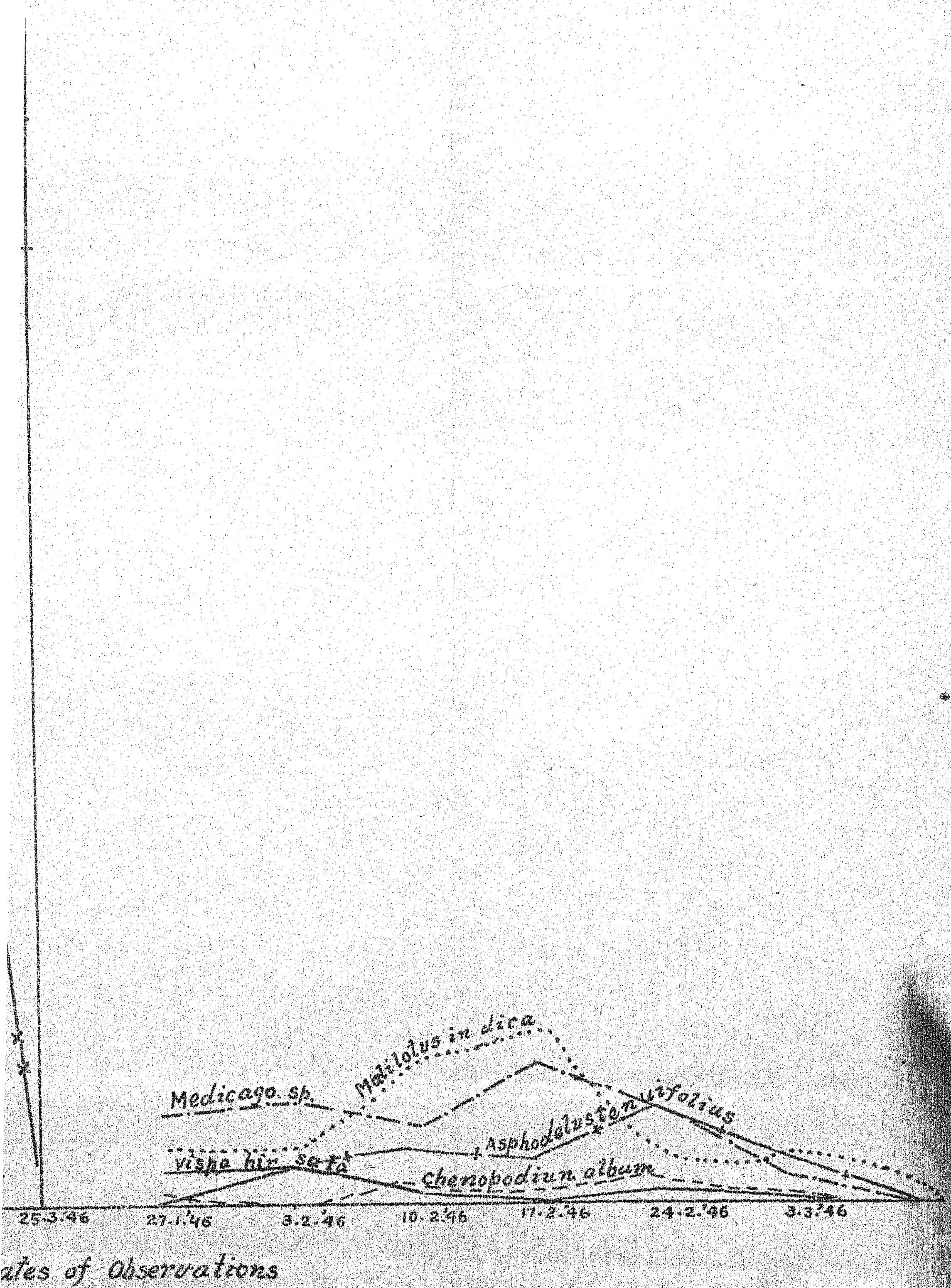
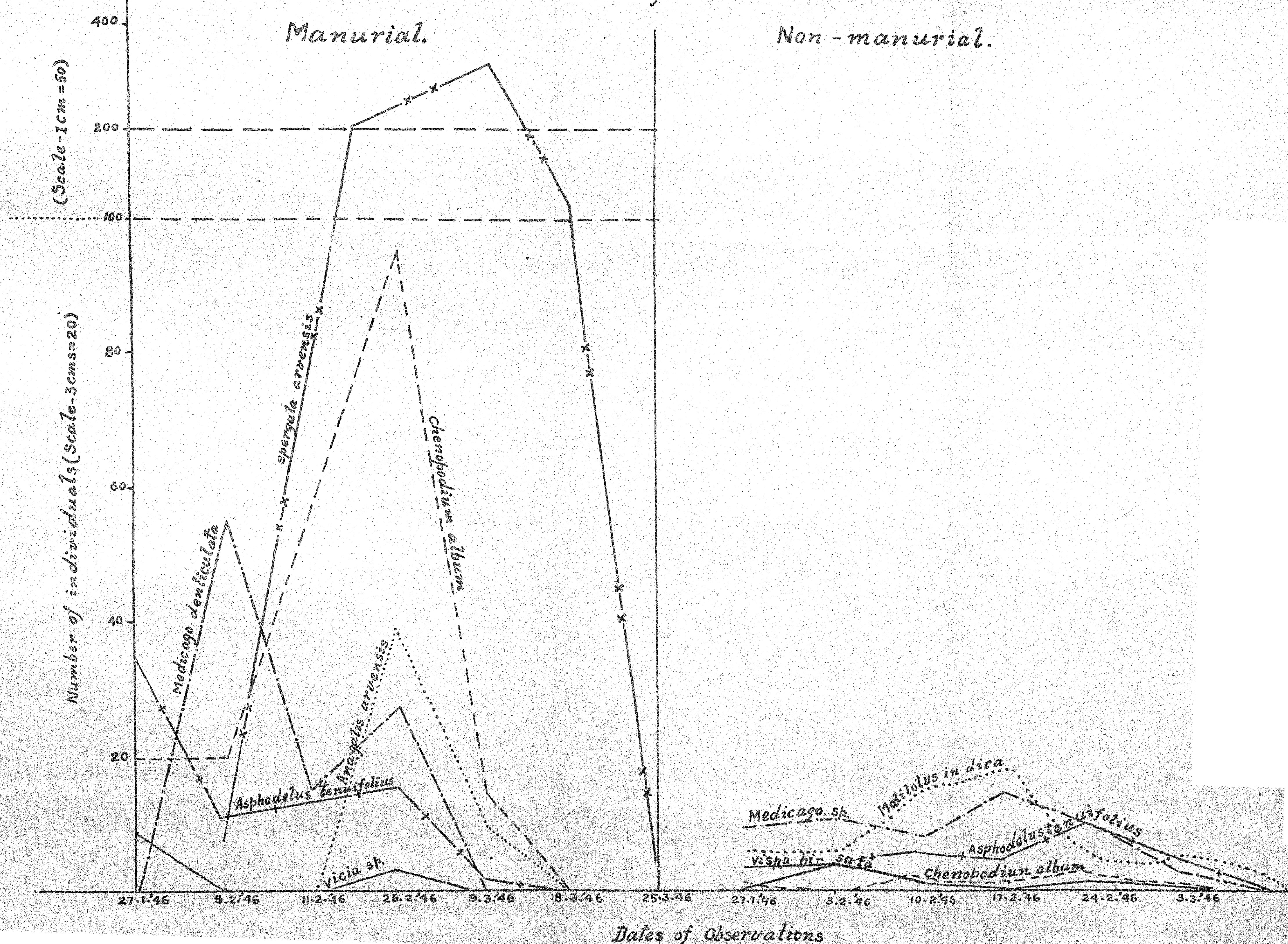


Figure-1



Manurial.
Non-manurial.
(Scale-1cm=50)
Number of individuals (Scale-3cms=20)
400
200
100
80
60
40
20
Spergula arvensis
Chenopodium album
Medicago denticulata
Anagalis arvensis
Asphodelus tenuifolius
Vicia sp.
Medicago sp.
Melilotus indica
Asphodelus tenuifolius
Vicia hirsuta
Chenopodium album
27.1.46
9.2.46
11.2.46
26.2.46
9.3.46
18.3.46
25.3.46
27.1.46
3.2.46
10.2.46
17.2.46
24.2.46
3.3.46
Dates of Observations